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The upper Bedoulian and lower Gargasian Ostracoda of the Aptian stratotype: Taxonomy and biostratigraphic correlation

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Abstract: In the vicinity of Saint-Saturnin-lès-Apt (Vaucluse, SE France), which is included in the area of the historic Aptian stratotype of Apt-Gargas, are four sections in a succession that permits the study in a very detailed and continuous way of the last beds of the upper Bedoulian and those of the lower Gargasian. The Ostracod content of the microfauna is relatively important and in a satisfactory state of preservation. 46 species have been indexed of which three are new: *Cytherella circumrugosa* nov. sp., *Cytherelloidea bedouliana* nov. sp. and *Parexophthalmocythere* (*Parexophthalmocythere*) sp. Until the present day, our comprehension of this group of microfossils in this stratigraphic interval was very fragmentary, not just in the Apt region but also in the Bedoulian historic stratotype area (Cassis-la Bédoule). This new study made it possible to determine a good number of species not previously reported in the stratotypes, to refine the generic status of many forms and to place some of them in open nomenclature.

The completion of a chronologic distribution chart collated with a recently published foraminiferal zonation (*Cabri*, *Luterbacheri* and *Ferreolensis* zones) shows very clearly the bipartite distribution of a good part of the Ostracod fauna. Accordingly, two ensembles are recognized, one at the end of the upper Bedoulian (index species *Protocythere bedoulensis*), the other characterizing the lower Gargasian, identified by the appearance and development of *Parataxodonta inornata*. The two groups are sharply separated by an episode of impoverished microfaunas at the base of the Gargasian.

Key Words: Aptian; historical stratotype; Ostracoda; taxonomy; biostratigraphy

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Résumé : *Les Ostracodes du Bédoulien supérieur et du Gargasien inférieur du stratotype d'Apt : Systématique et corrélations biostratigraphiques.*- Dans les environs de Saint-Saturnin-lès-Apt (Vaucluse, SE France), partie intégrante du secteur stratotypique historique de l'Aptien d'Apt-Gargas, une succession en relais de quatre coupes permet d'étudier de façon très détaillée et continue les dernières assises du Bédoulien supérieur et le Gargasien inférieur. Au sein de la microfaune, le contenu en Ostracodes s'est révélé relativement important et de conservation satisfaisante. 46 espèces ont été répertoriées, dont 3 nouvelles : *Cytherella circumrugosa* nov. sp., *Cytherelloidea bedouliana* nov. sp. et *Parexophthalmocythere* (*Parexophthalmocythere*) sp.

Jusqu'à présent nos connaissances sur ce groupe de microfossiles restaient très fragmentaires dans cet intervalle stratigraphique, aussi bien dans le secteur d'Apt que dans le stratotype historique du Bédoulien (Cassis - La Bédoule). Par cette nouvelle étude il a été possible de déterminer bon nombre d'espèces non encore signalées dans les stratotypes, d'affiner le statut générique de nombreuses formes et de placer quelques-unes d'entre elles en nomenclature ouverte.

La réalisation d'un tableau de répartition chronologiquement calibré sur une échelle zonale de Foraminifères récemment publiée (zones à *Cabri*, *Luterbacheri* et *Ferreolensis*) montre de façon nette la bipartition d'une bonne partie de l'ostracofaune. On distingue ainsi un premier ensemble daté de la fin du Bédoulien supérieur (espèce-index : *Protocythere bedoulensis*) et un deuxième ensemble caractérisant le Gargasien inférieur, marqué par l'apparition et le développement de *Parataxodonta inornata*. Ces deux ensembles sont nettement séparés par un épisode d'appauvrissement des microfaunes, situé à la base du Gargasien.

Mots-Clefs : Aptien ; stratotype historique ; Ostracodes ; systématique ; biostratigraphie

Introduction

For some ten years now, new research in the field and pluridisciplinary studies in

the laboratory have been in progress in the Aptian historic stratotypes of southeastern France. Old sections have been reinterpreted, and others, new ones, have been

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studied in detail. These sections are distributed between a first group attributed to the lower and middle Gargasian in the Cassis-Roquefort La Bédoule (Bouches-du-Rhône) area (MOULLADE *et alii*, 2004, 2005) and a second group, outcrops of upper Bedoulian-lower Gargasian age, that up to now have been studied only a little or not

at all, northwest of Apt near the hamlet of La Tuilière, in the parish of Saint-Saturnin-lès-Apt (Vaucluse) (Figs. 1-2). The general aspect and supplementary information on these sections is detailed in MOULLADE & TRONCHETTI, 2004 and MOULLADE *et alii*, 2006.

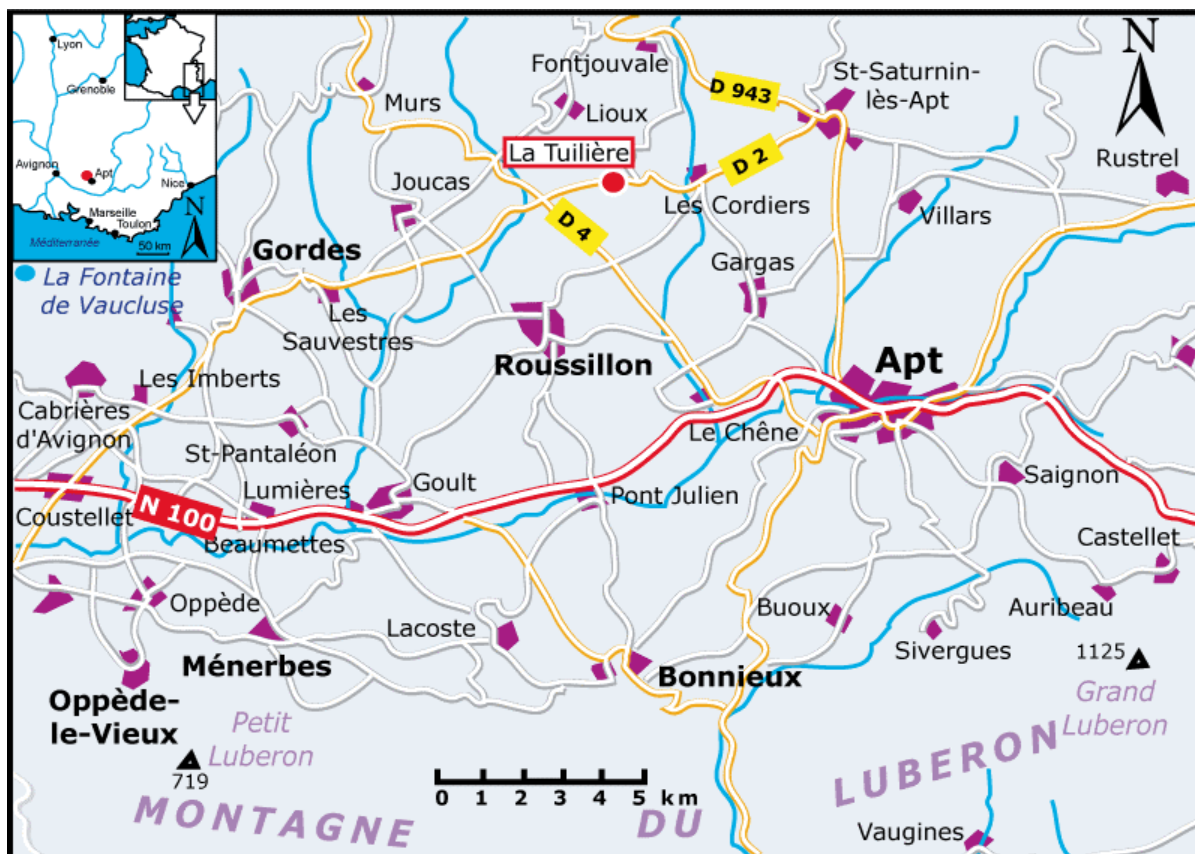


Figure 1: General map of the studied area (from MOULLADE *et alii*, 2006).

A zonal biostratigraphic framework made at Cassis using the distribution of planktonic and benthic Foraminifera (MOULLADE *et alii*, 2005) was applied in the La Tuilière sector (MOULLADE *et alii*, in preparation) and will be used as the basis for the establishment of the stratigraphic distribution of each species of Ostracod.

Information about the Ostracoda of the Aptian stratotypes is still fragmentary. The principal monographic publication about the Aptian-Albian of Apt is already old (OERTLI, 1958); the microfaunas were collected along a section northwest of Apt ending at the Gargas hill top. The author identified 20 species (among which 8 were new) that he attributed to the Gargasian-Lower Albian. Some have been figured in more general works (OERTLI, 1963), and later on with supplementary descriptions and precise details of nomenclature (BABINOT *et alii*, 1985). Components of

these associations have been reported in many areas of Western Europe.

In the framework of the pluridisciplinary activities mentioned above a first approach to the census and revision of the Ostracoda was completed for the Bedoulian (Lower Aptian) of the Cassis-La Bédoule stratotype (BABINOT, 1998). The number of species (in general very poorly preserved) counted in the type-Bedoulian is very small. Of the dozen forms present, only five could be determined.

Main results and biostratigraphic correlation

One of the major interests of this analysis is its contribution of new micropaleontologic data concerning a stratigraphic interval in the stratotype of the Aptian of Apt that was little or poorly known, namely the uppermost Bedoulian

and the lower Gargasian. This consequent improvement of our knowledge is gained from a composite section reconstituted in the stratotype area from a succession of several partial sections (which overlap to some extent), namely Pichouraz, La Tuilière W, Les Gays 1 and 2 (MOULLADE *et alii*, 2006).

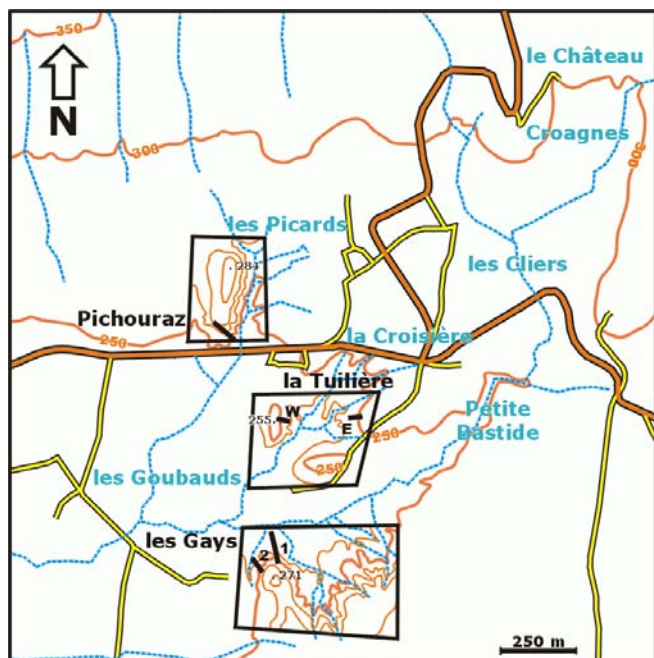


Figure 2: Detailed map of the studied area.

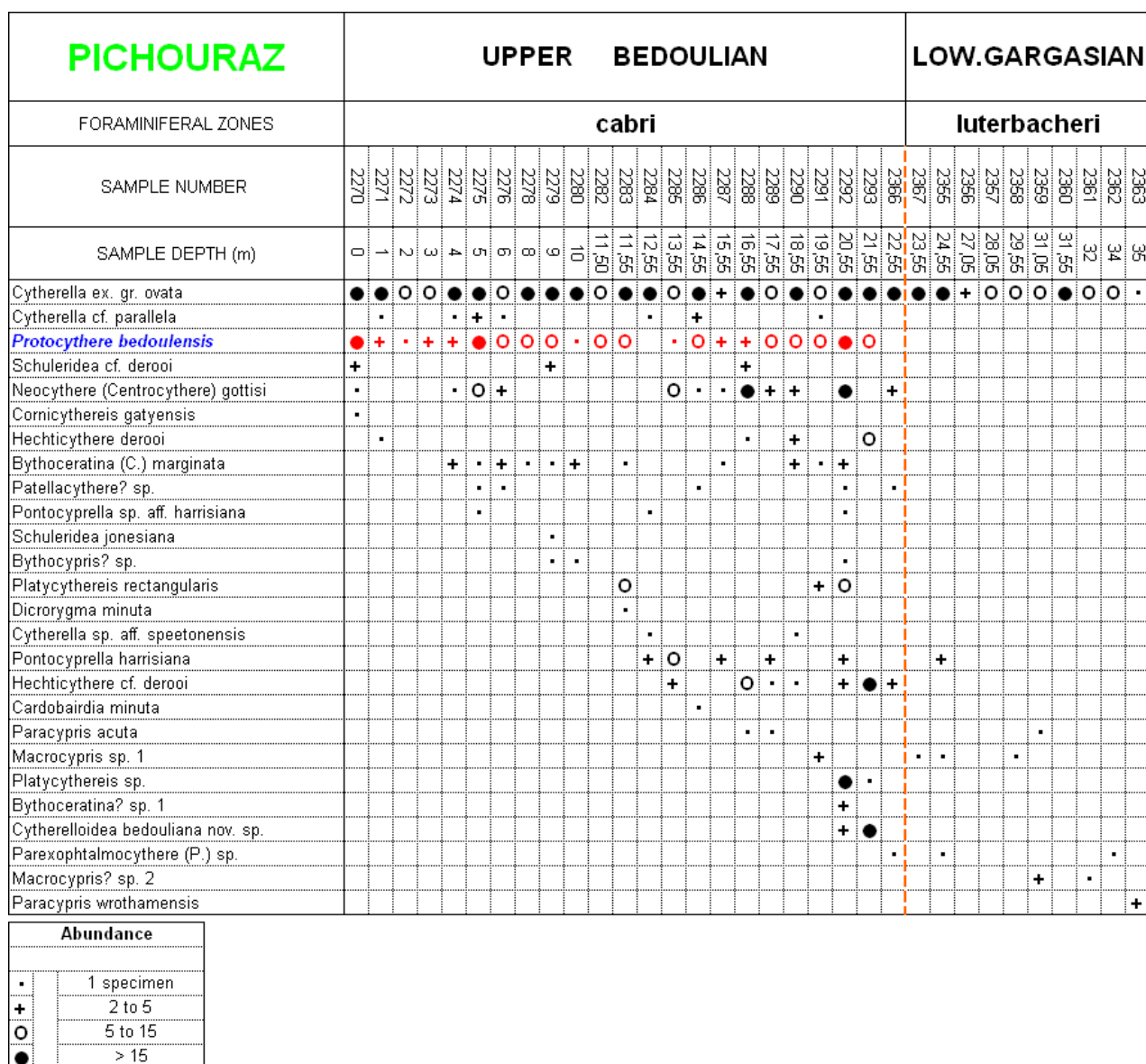
The material for study consists of 88 samples taken systematically at two or sometimes even one-meter intervals throughout the series. The forms identified were arranged in the chronological order of their appearance (Figs. 3, 4, 5, 6 & 7). Taxonomic uncertainties remain for some of them, often because of their poor preservation and/or their rarity. Although their internal morphologic and anatomic characteristics are difficult to interpret, these data are described and discussed in the systematics section because they may eventually be of use later on. Two species are described as being new: *Cytherella circumrugosa*, *Cytherelloidea bedoulana*, a third (*Parexophthalmocythere* (*Parexophthalmocythere*) sp.) was not named formally because of a lack of adequate material.

The biostratigraphic scale of Foraminifera mentioned above made possible a precise correlation of the assemblages of Ostracoda with the three biozones recognized on the basis of planktonic foraminifera: The *Cabri* Zone of the uppermost upper Bedoulian, the

Luterbacheri and *Ferreolensis* zones of the lower Gargasian. The continuity of the outcrops, apparently gapless, strengthens the local value of the range of each species and the descriptions of changes in the qualitative and quantitative composition of the associations.

46 species of Ostracoda were identified, among which 12 had already been listed and/or described in the Gargas Hill area (OERTLI, 1958; MOULLADE, 1965). The other species constitute two assemblages; one includes named species already reported in other regions (mainly Western Europe); the other is made up of specimens left in open nomenclature, with remarks concerning their generic status.

As the sections studied are globally under levels that previously cropped out extensively in the Gargas Hill area, it was logical and foreseeable that at La Tuilière there would be remains of strata older than the "Gargasien" (OERTLI's terminology, 1958). The presence of Bedoulian strata as shown by their Ammonites (DUTOIR, 2005) and Foraminifera (MOULLADE *et alii*, 2006), is consolidated by a relatively rich association of Ostracoda, with *Protocythere bedoulensis* as the marker. This species was described by MOULLADE (1963) at the extreme base of the "Gargasien" (*sensu* FABRE-TAXY *et alii*, 1965). CONTE (1994), on the basis of new collections of ammonites, placed this level in the terminal beds of the Bedoulian. A sporadic presence of *P. bedoulensis* has also been recognized in the Barremo-Aptian of the Vocontian Basin (MOULLADE, 1963), but this species had never been mentioned in the Apt stratotype sector. It is present quasi-permanently in the Pichouraz section (samples 2270 to 2293) in upper Bedoulian beds (top of the *Cabri* Zone). The uppermost beds of this substage are also marked by the sporadic presence of a new species of *Cytherelloidea* (described here as *C. bedoulana* nov. sp.) cited from and located in concomitant levels of the Cassis-La Bédoule stratotype (MOULLADE *in* FABRE-TAXY *et alii*, 1965) but without having been described formally. The upper Bedoulian is also marked by a special abundance of a dozen species (Figs. 3 & 7) of which half are confined to this interval: *Neocythere* (*C.*) *gottisi*, *Schuleridea* cf. *derooi*, *S.* aff. *harrisiana*, *Cornicythereis gatyensis*,



TUILIERE W.	UPP. BED.	LOW. GARGASIAN				
FORAMINIFERAL ZONES	cabri	luterbacheri				
SAMPLE NUMBER	2369	2351	2368	2370	2352	2354
SAMPLE DEPTH (m)	0	0.1	0.5	1.5	3	9
<i>Cytherella</i> ex. gr. <i>ovata</i>	O	●	●	+	●	+
<i>Cytherella</i> cf. <i>parallela</i>	▪	▪				
<i>Protocythere bedouliensis</i>	▪	+				
<i>Dicorygma minuta</i>					▪	
<i>Cytherella</i> sp. aff. <i>speetonensis</i>					▪	
<i>Pontocyprilla harrisiana</i>	▪					
<i>Parexophthalmocythere</i> (P.) sp.	▪	O	O			
<i>Pontocyprilla maynci</i>						▪
<i>Chapmanicytherura</i> cf. <i>kayei</i>						▪

Abundance	
▪	1 specimen
+	2 to 5
O	5 to 15
●	> 15

Figure 4: Distribution of Ostracoda in the La Tuilière W section.

permits the characterization of this portion of the lower Gargasian (upper levels of the *Luterbacheri* Zone and all of the *Ferreolensis* Zone). *Parataxodonta inornata* is its index fossil; it is interesting to note that the type of this form was described, "at the base of the Upper Aptian of the Isle of Wight" (KAYE, 1965b). The appearance of *Saxocythere tenuissima* at this level supports this dating. A total of 18 species demarcate this interval, of which a good number were described or mentioned by OERTLI (1958), and from which he reported the existence of the Gargasian.

Paleobiogeographic remarks

The composition of the microfaunas of Ostracoda from the type Aptian have strong affinities with those of the Lower Aptian of the Jura and the Paris Basin, the south and east of England, the Isle of Wight, the offshore of southern Ireland, and to a lesser extent with those of northern Germany and Portugal (Algarve). Another lot of specimens is also encountered in the Albion and Cenomanian of the same regions, with the addition of Netherlands. For the Aptian of the Jura (together with that of the Paris Basin) SAUVAGNAT (1999) calculated (p. 183) that

the JACCARD similarity index for sites in southeastern France was 13 to 31%. On the basis of the precisions provided by our study these index data may be revised upward.

Systematics (J.-F.B.)

To lighten the text, the following abbreviations are used: RV = right valve; LV = left valve; DM = dorsal margin; VM = ventral margin; AM = anterior margin; PM = posterior margin, C = carapace (complete shell, *i.e.* both valves) (plate legends).

Species are presented using the basic classification of HARTMANN & PURI (1974), revised and updated by several more recent developments (GRÜNDEL, 1966, 1971, 1973, 1974, 1975a, 1975b, 1976, 1978; WILKINSON, 1988; MADDOCKS & STEINECK, 1987).

In an additional effort toward brevity, with the exception of special cases, we refer the reader to the list of synonyms established by J. SAUVAGNAT (1999) with regard to the Aptian-Albian of the Jura.

All of the material and the types figured are deposited in the collections of the Sedimentology and Paleontology Center of the University of Provence, Saint-Charles Campus, Marseilles.

Subclass OSTRACODA LATREILLE, 1802

Order PLATYCOPIDA SARS, 1866

Suborder PLATYCOPINA SARS, 1866

Family CYTHERELLIDAE SARS, 1866

Genus *Cytherella* JONES, 1849

Cytherella ex gr. *ovata* (ROEMER, 1841) (Pl. 1, figs. 1-3)

1841 - *Cytherina ovata*, ROEMER: Norddeutsches Kreidegebirge, p. 104, pl. 16, fig. 21.

Remarks. In his 1966 work, HERRIG presents an important synonymic list for this species, a list that was completed later on (DAMOTTE, 1971; BABINOT, 1980; SAUVAGNAT, 1999). If the paleoecologic interest of this form is far from being negligible, it is not the same for any kind of biostratigraphic application. It is reported in the whole of the Cretaceous of Europe (except perhaps in the Berriasian) from the Boreal domain to the Mesogean area. In the sector studied it is present in almost every sample, always in an important and constant number of individuals.

LES GAYS 1		LOWER GARGASIAN																																					
FORAMINIFERAL ZONES		luterbacheri																				ferreolensis																	
SAMPLE NUMBER		2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343
SAMPLE DEPTH (m)		2.5	5.5	7.5	9.5	12.5	14.5	16.5	18.5	20.5	22.5	24.5	26.5	28	29.5	31	33	36	38.5	40.5	43	45.5	48	50	52.5	54	56	58	60	62	64	66	68	70	72	74			
Cytherella ex. gr. ovata		●	●	●		•		+	+	+	●	●	○	+	●	●	○	●	●	○	●	●	○	+	+	●	●	●	●	●	●	●	●	○	○	○	○	○	
Cytherella cf. parallela											•													+	+		•	•	•	•	•	•	•	•	•	•	•	•	
Schuleridea cf. derooi																								+	•														
Hechticythere derooi																										+													
Platycythereis rectangularis																																							
Dicrorygma minuta																																							
Cytherella sp. aff. speetonensis						•																				•													
Hechticythere cf. derooi																								•															
Cardobairdia minuta																																							
Paracypris acuta					+	•										+					•	+				+											•	•	
Macrocypris sp. 1																																							
Platycythereis sp.																									○														
Paracypris wrothamensis																							+	+	•	+	+		•		+	+	+	+	+	+	+		
Pontocyprilla maynci																								•	+	+	+	+	•										
Chapmanicytherura cf. kayei																								•	+	+	+	•	•										
Parataxodonta inornata																							+	+	+	○	+		•	•	•	•	○	•	•	•	○		
Phodeucythere cf. trigonalis																								•															
Paranotacythere catalaunica																								•		+													
Dolococytheridea (P.) sp. aff. bosquetiana																								○	+	•													
Dolococytheridea ? sp.																								•															
Saxocythere tenuissima																								•															
Rehacythereis buechlerae																								+															
Cytherella circumrugosa																																							
Pedellacythere sp. aff. pitstonensis																																							
Bythoceratina sp. 2																																							
Microceratina ? sp.																																							
Dolococytheridea (P.) intermedia																																							
Liasina rectimarginata																																							
Cytheropteron sp. aff. nanissimum																																							
Eocytheropteron stchepinskyi																																							
Abundance																																							
•	1 specimen																																						
+	2 to 5																																						
○	5 to 15																																						
●	> 15																																						

Figure 5: Distribution of Ostracoda in the Les Gays 1 section.

***Cytherella cf. parallela* (REUSS, 1846)**
(Pl. 1, fig. 4)

1846 - *Cytherina parallela*, REUSS: Böhm. Kreide, p. 16, pl. 5, fig. 33.

Synonymy list: See the compilations listed in the preceding.

Remarks. If the bibliographies of the last few decennia are consulted it seems that if construed strictly the species would exist only in the northern domains of Europe. OERTLI (1958) reported some slight morphologic variations between individuals of the Aptian-Albian of Apt and Bohemian topotypes, notably in the PM of the valves. Also without real stratigraphic interest, *C. cf. parallela* is much rarer than *C. ex gr. ovata* and is encountered only sporadically in all the sections.

***Cytherella circumrugosa* nov. sp.**
(Pl. 1, figs. 5-7)

Origin of the name: Presence of ridges on the periphery of the valves.

Holotype: A LV, n° HAP 1, deposited in the Centre de Sédimentologie et Paléontologie, University of Provence, Saint-Charles Campus, Marseilles.

Paratypes: 2 valves, n° PAP 1/1 and PAP 1/2

Stratum typicum: Les Gays section 1 (sample 2342)

Diagnosis: Relatively large in size, DM and VM subparallel, a set of peripheral concentric ridges that weaken progressively toward the inner portion of the surface of the valves.

Description:

a) Left valve (holotype): Regularly inflated; AM and VM generally parallel, but each with a weak concavity, clearly defined on the anterior third of the DM (well-developed frontal lobe), on the VM less well-marked and in a median position. AM and PM regularly rounded, the AM broader. System of wavy ridges on the outer edge, well defined at the front end (5-6 ridges clearly visible) that attenuate progressively in the ventral and posterior areas. These ridges may anastomose by means of small bridges that connect them in an orderly way; they are less well-defined but visible under high magnification toward the valve surface.

b) Right valve (paratypes): It differs from the LV in that the DM is divided into two parts (forming an angle in the posterior quarter). The PM is narrower than the AM with a maximum convexity in the ventral half. The ridge system is similar.

Affinities: Very similar in shape to *Cytherella* aff. *contracta contracta* VEEN, 1932 (*in* WEAVER, 1982) of the Cenomanian of England, but in that species the front part of the carapaces are more flattened and apparently smooth.

Dimensions (type series and topotypes grouped):

Length: 0.72-0.85 mm

Height: 0.34-0.41 mm

Distribution: Lower Gargasian of Les Gays 1 and 2.

***Cytherella* sp. aff. *speetonensis* KAYE, 1963**
(Pl. 1, figs. 8-10)

1963a - *Cytherella speetonensis*, KAYE: *Cytherellidae* Brit. Lower Cret., p. 112, pl. 18, figs. 7-8.

Remarks. The small number of specimens in our material does not permit a reliable determination of this species. It differs from *C. circumrugosa* nov. sp. in that the DM and VM are more convergent toward the posterior end, the dorsal concavity is more attenuated and there is no ornamentation.

Distribution: Upper Bedoulian of Pichouraz, lower Gargasian of La Tuilière W and Les Gays 1. Lower Aptian of the Jura.

Genus *Cytherelloidea* ALEXANDER, 1929
***Cytherelloidea bedoulia* nov. sp.**
(Pl. 1, figs. 11-14)

1963b - *Cytherelloidea* sp. 1, DAMOTTE & GROSIDIER: *Ostr. Crétacé inf. Champagne. II.* Aptien, p. 154, pl. 1, fig. 2a-c.

Origin of the name: After the Bedoulian age of the type-level

Holotype: One RV, n° HAP 2, deposited in the Centre de Sédimentologie et Paléontologie, University of Provence, Saint-Charles Campus, Marseilles.

Paratypes: 19 valves, Numbers. PAP 2/1 to PAP 2/19.

Stratum typicum: Top of the upper Bedoulian, Pichouraz section (sample 2300 # 2293).

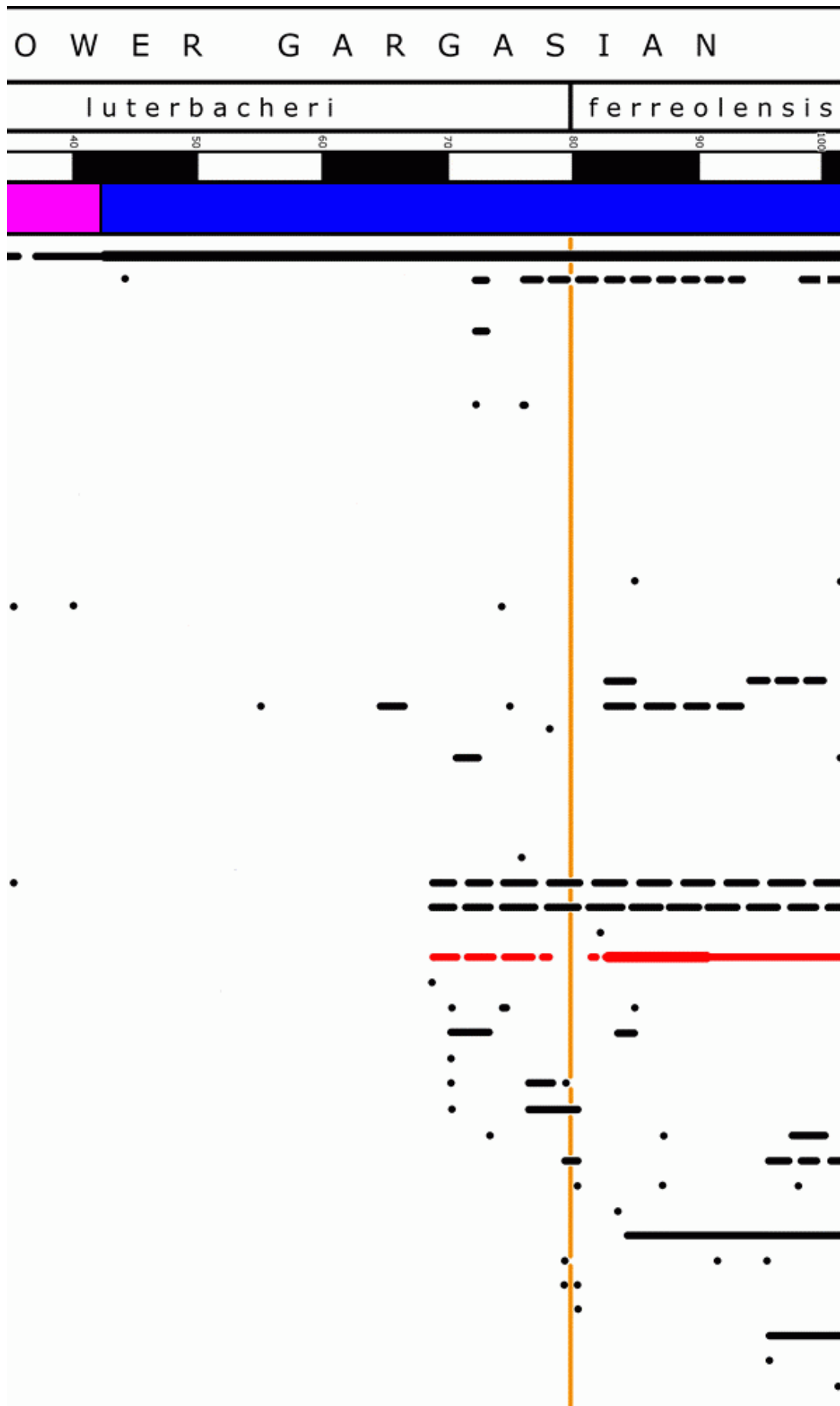
LES GAYS 2		LOWER GARGASIAN										
FORAMINIFERAL ZONES		Int.	ferreolensis									
SAMPLE NUMBER		2346	2345	2344	2305	2364	2304	2303	2302	2301		
SAMPLE DEPTH (m)		0	2	4	6	10	14	18	22.5	26.5		
Cytherella ex. gr. ovata		○	●	●	●	○	●	●	●			
Cytherella cf. parallela					+	•		+	•			
Platycythereis rectangularis										•		
Dicrorygma minuta										+		
Cardobairdia minuta				+	+			○	+			
Paracypris acuta		•		+	•	•						
Macrocypris sp. 1		•										
Platycythereis sp.										•		
Macrocypris? sp. 2		•										
Paracypris wrothamensis		+	+	○	○	+		+		+		
Pontocyprilla maynci		•	•	+	○			○		+		
Parataxodonta inornata				○	○	●	○	+	+	○		
Paranotacythere catalaunica		•		•	+							
Saxocythere tenuissima			•									
Rehacythereis buechlerae		•	○	○								
Cytherella circumrugosa					•			+	+			
Pedellacythere sp. aff. pitstonensis		+	•						•	•		
Bythoceratina sp. 2						+			•			
Dolococytheridea (P.) intermedia					○	○	○	+	○	○	+	
Liasina rectimarginata		•						•	•			
Cytheropteron sp. aff. nanissimum		•	•									
Eocytheropteron stchepinskyi			•									
Neocythere (Neocythere) mertensi									•	○		
Polycopse oweni									•			
Rehacythereis cf. bartensteini										•		

Abundance	
•	1 specimen
+	2 to 5
○	5 to 15
●	> 15

Figure 6: Distribution of Ostracoda in the Les Gays 2 section.



Figure 7: Composite distribution of Ostracoda in the upper Bedoulian-Lower Gargasian of the area of La Tuilière.



Diagnosis: AM widely spread out, bounded by a narrow ridge, dorsal ridge in two segments, rear overhung by a rectilinear ridge ornamented with spiny nodes at the ends, surface of valves coarsely reticulate.

Description: AM very widely spread out, regularly curved, projecting far over the VM for a third of its length; DM straight, VM short, slightly sinuous in outline; PM rounded, with a stronger mid-dorsal convexity. The lateral surface has a system of ridges with a) a very thin, salient anterior ridge of which the trace joins the basis of the antero-dorsal angle to the forward end of the VM, b) a dorsal ridge in two segments that are more or less well-connected, c) a thicker and convex ridge parallel to the ventral margin, d) a posterior ridge-like relief, rectilinear or slightly arched, overhanging the PM, with spiny nodes at the two extremities, of which the importance varies from one individual to another. Fine spines fringe the PM and there is a mid-dorsal circular depression (a trait common to many species of this genus). The valve surfaces are ornamented by a rather coarse, embossed reticulation.

Affinities: *Cytherelloidea bedouliana* nov. sp. has morphologic features that are the same as those of *Cytherelloidea* sp. 1 DAMOTTE & GROSDIDIER of the Lower Aptian of Louvement (Haute-Marne), so this form is placed in synonymy. Our species is also very close in ornamentation to *Cytherelloidea* sp. 2 from the Barremian of the Vocontian domain (SCARENZI-CARBONI, 1984, unpublished), but in that form the DM and VM are much closer to being parallel (front part not inflated). *C. kayei* WEAVER, 1982 from the Cenomanian of England has a posterior zone with a different configuration. *Cytherelloidea* sp. 1 CABRAL, 1995 from the Lower Aptian of the Algarve (Portugal) is narrower, with the front less spread out and the posterior reliefs simpler.

It is very interesting to report that this form had already been considered as new under the name *Cytherelloidea* n. sp. MOULLADE (*in* FABRE-TAXY *et alii*, 1965, p. 196 and tabl. fig. 10), but it was neither described nor figured because of a paucity of material. The authors mentioned its presence at the Bedoulian-Gargasian (*sensu ante*) boundary of the stratotype at Cassis-La Bédoule. In the same sector it

was found at the top of the "Comte Quarry" (basal Gargasian) (Coll. MOULLADE). So *C. bedouliana* may be considered as a marker of the Bedoulian-Gargasian transition.

Dimensions:

Length: 0.40-0.83 mm

Width: 0.27-0.38 mm

Distribution: Upper Bedoulian-basal Gargasian at Pichouraz and Cassis-La Bédoule (Aptian stratotypes); Lower Aptian of the Haute-Marne (Champagne).

Order CLADOCOPIDA SARS, 1866
Suborder CLADOCOPINA SARS, 1866
Family POLYCOPIIDAE SARS, 1866
Genus *Polycope* SARS, 1866
***Polycope oweni* KAYE, 1965**
(Pl. 1, fig. 16)

1965a - *Polycope oweni*, KAYE, Brit. Alb. Ostr., p. 222, pl. 4, figs. 11-15.

Remarks. Only one specimen is available, but it is typical of the genus. Ornamentation is in the form of aligned microtubercles which constitute a network in the form of a polygonal mesh. This arrangement appears slightly less dense than on the specimens figured in previous publications.

Distribution: Lower Gargasian of Les Gays 2. Middle Albian of the Jura, Middle-Upper Albian of England.

Order PODOCOPIDA MÜLLER, 1894
Suborder PODOCOPINA SARS, 1866
Superfamily AMIRIDIACEA SARS, 1888
Family AMIRIDIIDAE SARS, 1888
Genus *Cardobairdia* BOLD, 1960
***Cardobairdia minuta* (VEEN, 1936)**
(Pl. 2, figs. 15-17)

1936 - *Krausella minuta*, TRIEBEL *in* VEEN: Cytheridae Maastr. Tuffkreide, p. 176, pl. 10, figs. 7-15.

1940 - *Krausella minuta* TRIEBEL - BONNEMA: Untergr. nord. Niederlande, p. 115, pl. 3, figs. 32-34.

1958 - *Krausella minuta* TRIEBEL - HOWE & LAURENCHICH: Introd. Cret. Ostr., p. 376 (scheme)

1958 - *Krausella* ? sp. 301, OERTLI: Ostr. Apt. Alb. Apt, p. 1503, pl. II, figs. 39-41.

1960 - "*Krausella*" *minuta* TRIEBEL - BOLD: Eocene Oligoc. Trinidad, p. 155, pl. 6, fig. 3.

1963 - *Krausella minuta* TRIEBEL - KAYE & BARKER: Ostr. Sutterby Marls, p. 376, pl. 48, figs. 12, 14.

1966 - *Cardobairdia minuta* (TRIEBEL) - HERRIG: Ostr. Maastr. Rügen, p. 772, pl. XV, figs. 1-4.

1982 - *Cardobairdia minuta* (VEEN) - WEAVER: Ostr. Brit. Lower Chalk, p. 20, pl. 19, figs. 15-19.

Remarks. Although this species is relatively rare it is known throughout the Middle-Upper Cretaceous of Europe. It was reported originally by TRIEBEL in 1936, but the work was never published. So VEEN is the author of this form (WEAVER, 1982).

The La Tuilière material is externally identical to that described and figured by OERTLI (1958) under the name *Krausella* ? sp. 301 and also very close to specimens from England, with the two valves smooth and dissymmetric, the LV overlapping the RV, except posteriorly. KAYE & BARKER (1965) indicate that the hinge appears to be reduced to "a simple overlap". A cardinal structure has been studied by electron microscope (RV, Pl. 2, fig. 16a): It is of an antimerodont type with a long, low anterior tooth divided into 10 to 12 denticles and a more prominent posterior tooth also crenellate, rising up posteriorly. This layout is analogous to that figured by HERRIG (1966, text-fig. 47) on the basis of specimens from the Maastrichtian of the island of Rügen, that he placed in the genus *Cardobairdia* that was defined in the Eocene-Oligocene of Trinidad (BOLD, 1960). Note, however, that the specimens from Rügen are slightly larger. The long time-span of this apparently static form is thus confirmed.

The genus *Krausella* (? Krausellidae BERDAN, in MOORE, 1961) has a hinge without teeth and is known only in the Ordovician-lower Silurian and hence cannot be considered for the generic assignment of this species.

Distribution: A unique individual in the upper Bedoulian at Pichouraz. It appears to be more widely distributed in the lower Gargasian of Les Gays 1 and 2, in the "Albien inférieur" (fide OERTLI, 1958) of Apt. Upper Aptian (Lincolnshire) and Cenomanian of England. Maastrichtian of Germany and the Netherlands.

Family BYTHOCYPRIDIDAE MADDOCKS, 1969
Genus *Bythocypris* BRADY, 1880
Bythocypris ? sp.
 (Pl. 1, fig. 15)

Remarks. Very rare, poorly preserved specimens with a closed carapace. Even the generic attribution is a little uncertain. *Bythocypris* ? sp. SAUVAGNAT, 1999 from the Lower Aptian of the Jura has a more elongate carapace.

Distribution: Upper Bedoulian of Pichouraz.

Superfamily CYPRIDACEA BAIRD, 1845
Family MACROCYPRIDIDAE MÜLLER, 1912
Genus *Macrocypris* BRADY, 1867
Macrocypris sp. 1
 (Pl. 1, fig. 20)

Remarks. Morphologic criteria and size conform with those of the genus. Very rare, this form is close to *Macrocypris* sp. 302 OERTLI 1958 from the "Lower Albien" of Apt, but the valves of this form are larger.

Distribution: Uppermost Bedoulian and lower Gargasian of Pichouraz.

Macrocypris ? sp. 2
 (Pl. 1, figs. 18-19)

Remarks. Large valves, rare, often deformed as flattened closed carapaces. The PM is very elongated along the median longitudinal axis. Its assignment to the genus *Macrocypris* remains hypothetical because of its odd shape

Distribution: Lower Gargasian of Pichouraz and Les Gays 2.

Family PARACYPRIDIDAE SARS, 1923
Genus *Paracypris* SARS, 1866
Paracypris acuta (CORNUEL, 1848)
 (Pl. 1, fig. 17)

1848 - *Cythere acuta*, CORNUEL: Foss. Micro. Crét. Inf. Haute-Marne, p. 242, pl. 1, figs. 7-8.

Remarks. A "classic" form of the European Lower Cretaceous, of moderate size, with a very acuminate PM and a strong ventral concavity. Of little stratigraphic value, for it is reported from the upper Wealden to the Aptian by many authors (see synonymic list and commentary in SAUVAGNAT, 1999).

Distribution: Occurs in all of the sections studied at La Tuilière. Hauterivian-Aptian of France (Paris Basin, Jura, Ardèche, Vercors), England and Ireland (off the south coast). Wealden-Barremian of Germany.

Paracypris wrothamensis KAYE, 1965
 (Pl. 2, figs. 1-3)

1961 - *Paracypris* sp. 1, GROSDIDIER: Ostr. Crét. Champagne, p. 6, pl. 2, figs. 38-40.

1965a - *Paracypris wrothamensis*, KAYE: New Brit. Alb. Ostr., p. 226, pl. 9, figs. 9-14.

Remarks. This large species is differentiated because of the rather

unusual trace of the dorsal margin, particularly of the RV (the anterior cardinal angle juts out behind a concave portion that connects with the AM). Its comparison with other forms is given in the original description (KAYE, 1965a, p. 227). On the other hand, *P. cf. jonesi* BONNEMA, 1940 is reported in the "Aptian - Albian" of Apt (OERTLI, 1958): This species probably comes from higher levels on the Gargas Hill. It is less elongated and has no prominent dorsal angulosities.

Distribution: Sparse, but always present in the lower Gargasian of Les Gays 1 and 2. Albian of the Paris Basin and Jura; Albian-Cenomanian of England.

Family PONTOCYPRIDIDAE MÜLLER, 1894
Genus Pontocyprilla LJUBIMOVA, 1955
Pontocyprilla harrisiana (JONES, 1849)
 (Pl. 3, figs. 11-12)

1849 - *Cythere (Bairdia) harrisiana*, JONES: Entomotr. Cret. England, p. 25, pl. 6, fig. 17.

Remarks. The outline of the valves of the specimens seen conforms exactly with those figured by many authors. *P. rara* KAYE, 1963, from the Lower Aptian of Lincolnshire, identical in all points with *P. harrisiana*, was made synonymous legitimately by WEAVER (1982). The forms figured by SAUVAGNAT (1999) in the Upper Albian of the Jura have more ventral and more pointed PM.

Distribution: Upper Bedoulian of Pichouraz, extremely rare in the lower Gargasian. Albian of the Jura, Albian-Cenomanian of England, Germany, Netherlands, Poland, Bulgaria

Pontocyprilla sp. aff. *harrisiana* (JONES, 1849)
 (Pl. 3, figs. 9-10)

Remarks. Form close to the preceding, but smaller in size and with a slightly more ventral PM. These few specimens may be juvenile forms of *P. harrisiana*, but the paucity of our material does not permit certainty in this regard.

Distribution: Upper Bedoulian of Pichouraz.

Pontocyprilla maynci OERTLI, 1958
 (Pl. 3, figs. 13-17)

1958 - *Pontocyprilla maynci*, OERTLI: Ostr. Apt. Alb. Apt, p. 1504, pl. II, figs. 46-54; pl. III, figs. 55-60.

1985 - *Pontocyprilla maynci* OERTLI - BABINOT et

alii: Atlas Ostr. France, pl. 48, fig. 4.

Remarks. Species characterized by the fact that "la hauteur maximale mesure très régulièrement presque 60% de la longueur" ("the maximum height measures very regularly almost 60% of the length" (in original diagnosis, OERTLI, 1958, *loc. cit.*)). The information concerning the characteristics of the hinge is perfectly confirmed.

Distribution: Lower Gargasian of La Tuilière W and of Les Gays 1 and 2. "Aptian - Albian" of Apt.

Genus Liasina GRAMANN, 1963
Liasina rectimarginata (NUYTS, 1990)
 (Pl. 6, figs. 20-21)

? 1940 - *Cytheridea bemelenensis* VEEN - BONNEMA: Ostr. Kreide Untergr. Niederlande, p. 115, pl. 3, figs. 35-38.

1990 - *Cardobairdia rectimarginata*, NUYTS: *Krausella minuta nomen nudum* and three new sp. Cenomanian S. England, p. 67, pl. 1, figs. 5-8.

1992 - *Cardobairdia rectimarginata* NUYTS - WITTE *et alii*: Ostr. Alb/Cenoman. Netherlands, p. 49, pl. 2, figs. 8-9.

1993 - *Iliffeoecia rectimarginata* (NUYTS) - WOUTERS: Cret. Interst. genus *Iliffeoecia*, p. 57, pl. 1, fig. 12; pl. 2, figs. 5-8.

1998 - *Liasina rectimarginata* (NUYTS) - WOUTERS: Genus *Liasina*, low div. lineage, p. 122.

Remarks. *Cardobairdia rectimarginata* NUYTS from the Lower Cenomanian of England was classed in the genus *Iliffeoecia* (WOUTERS, 1993); this genus was later considered as a more recent synonym of *Liasina* GRAMANN (WOUTERS, 1998). The same species was collected in the Lower Cenomanian of the Netherlands (WITTE *et alii*, 1992). Specimens almost identical to the illustrations of WITTE *et alii* are present, but very rare in our material. Internal structures are not visible.

Small, quadrangular in outline, without ornamentation, *Liasina* is considered to be an old taxon (first representatives in the Sinemurian) and is still present in the Recent. The line of descent includes in particular *L. vestibulifera* (GRAMANN, 1963) and *L. lanceolata* (APOSTOLESCU, 1959), respectively from the Lias of Germany and the Bathonian of the Paris Basin, and *L. rectimarginata* (NUYTS, 1990) of the Cenomanian of England and the Netherlands. Now living in the Pacific, Indian and Atlantic oceans is *L. iliffei* (MADDOCKS,

1986) (= new genus, new species MADDOCKS & ILIFFE, 1986) and *L. varuensis* (WOUTERS, 1996).

WOUTERS (1998) insists on the very small amount of diversification in this lineage, with this species that has lasted at least 25 to 30 MA (from Cenomanian to Maastrichtian). The assimilation of our specimens with this last-named form would increase even more the stability of the adaptation (morphologic stasis) which thus increases to more than 50 MA. This longevity might be due to an unchanged marine interstitial habitat, considered, in particular in Ostracoda, as one of the oldest adaptive habitats (WOUTERS, 1993, 1998).

Distribution: Lower Gargasian of Les Gays 2. Cenomanian of England and the Netherlands. ? Lower Maastrichtian of the Netherlands.

Superfamily CYTHERACEA BAIRD, 1850
Family BYTHOCERATIDAE SARS, 1926
Subfamily BYTHOCERATINAE SARS, 1926
Genus *Bythoceratina* HORNIBROOK, 1952

Specimens attributable to the subfamily Bythoceratinae are disseminated (in small numbers) in all of the sections. Their preservation is defective, they are often encrusted and/or broken; the reliability of their determination as to species (even to genus) is therefore subject to caution. Four different forms have been recognized, but only one is worthy of discussion.

Sugenus *Bythoceratina* (*Cuneoceratina*)
GRÜNDEL & KOZUR, 1971
Bythoceratina* (*Cuneoceratina*) *marginata
WEAVER 1982
(Pl. 2, figs. 6-8)

1982 - *Bythoceratina* (*Cuneoceratina*) *marginata*, WEAVER: Ostr. Brit. Lower Chalk, p. 47, pl. 7, figs. 5-7.

Remarks. In our material this form is the most abundant representative of the species of the genus *Bythoceratina*.

Description: DM slightly arched, AM regularly rounded, bounding a crescentic flattened area; PM raised upward and linked to the VM by a slightly concave trace. Central area with an antero-median node linked by an arc to a massive dorsal coast that is attenuated posteriorly. A second massive medio-ventral tubercle

overhangs the medio-dorsal area thus forming a depression that varies with the individuals. It was not possible to see internal characteristics.

Affinities: *Bythoceratina umbonata glabra* WEAVER, 1982 of the Lower Cenomanian has a similar outline, but the antero-dorsal and ventral bulges are much less prominent (see also WITTE *et alii*, 1992, pl. 3, fig. 12).

Distribution: Relatively constant, but with a few individuals in the upper Bedoulian of Pichouraz. Lower Cenomanian of England.

Sugenus *Bythoceratina* (*Bythoceratina*)
HORNIBROOK, 1952
***Bythoceratina* ? sp. 1**
(Pl. 2, fig. 5)

Description: Rare, small in size. Ornamentation in the form of a regularly spaced punctuation, absent posteriorly. Short medio-ventral, sinuous ridge and slight mid-dorsal depression.

Distribution: In two samples from the uppermost Bedoulian of Pichouraz.

***Bythoceratina* sp. 2**
(Pl. 2, figs. 9-10)

Remarks. Also rare, this form resembles *Bythoceratina* (C.) *marginata*, but the lay-out of the details of ornamentation is different. Almost all the available specimens are broken.

Distribution: Lower Gargasian of Les Gays 1 and 2.

Genus *Patellacythere* GRÜNDEL & KOZUR,
1971
***Patellacythere* ? sp.**
(Pl. 2, fig. 4)

Remarks. In this form certain characters of *Bythoceratina* (C.) *marginata* are found, but the valve is shorter, the PM less acuminate, the medio-ventral tubercle very blunt. There are some analogies with *Patellacythere parva* WEAVER, 1982 from the Cenomanian of England. It is also possible that this form is the larval stage of *B.* (C.) *marginata*. There is not enough material available to forge a reliable opinion regarding the precise taxonomic position of this form.

Family CYTHERIDEIDAE SARS, 1925
Subfamily CUNEOCYTHERINAE MANDELSTAM, 1960

Genus *Dicrorygma* POAG, 1962
***Dicrorygma minuta* (KAYE, 1963)**
(Pl. 2, figs. 11-14)

1963b - *Dolocytheridea minuta*, KAYE: Mesoz. Ostr. Cytherideidae, p. 34, pl. 1, figs. 4-5.

1966 - *Dicrorygma* (*Dicrorygma*) *minuta* KAYE - GRÜNDEL, Ostr. Unterkreide Deutschland, p. 19, pl. 2, figs. 26-27; pl. 10, fig. 3.

Remarks. This species was described originally from the Hauterivian-Barremian of England (Speeton Clay) and attributed to the genus *Dolocytheridea*. GRÜNDEL (1966) restudied the species and from its characteristics (hinge, marginal zones and pore canals) placed it in the genus *Dicrorygma*. This opinion was accepted by several authors on material from the Lower Cretaceous (COLIN *et alii*, 1981; CABRAL, 1995; SAUVAGNAT, 1999). The specimens studied here are slightly more elongate, but the differences are small: The shape, valve volume and mode of overlapping justify a very probable identification with this species.

Distribution: Very rare specimens in four samples from the upper Bedoulian-lower Gargasian of Pichouraz and Les Gays. Hauterivian of Germany. Hauterivian-Barremian of England. Lower Aptian of the Paris Basin and Jura. Lower Aptian of the Isle of Wight (England) and of the offshore of Ireland (North Celtic Sea Basin). Aptian of the Algarve (Portugal).

Subfamily SCHULERIDEINAE MANDELSTAM, 1950

Genus *Schuleridea* SWARTZ & SWAIN, 1946
***Schuleridea jonesiana* (BOSQUET, 1852)**
(Pl. 2, fig. 18)

1849 - *Cythere hilseana* (ROEMER, 1841) - JONES: Entom. Cret. England, p. 10, pl. 1, fig. 1.

1852 - *Cytheridea jonesiana* nom. nov. - BOSQUET: Entom. France, Belgique, p. 38.

1956 - *Schuleridea jonesiana* (BOSQUET) - MERTENS: Alb./Cen. NW Deutschland Ostr., p. 193, pl. 10, figs. 38-40.

Remarks. This species is very widespread in Europe. Shape, ornamentation and hinge confirm that our material conforms to that of the original diagnosis.

Distribution: Upper Bedoulian of Pichouraz. Aptian to Cenomanian of France (Paris Basin, Jura, Provence), England, Ireland, Germany, the Netherlands, Bulgaria, northern Spain.

***Schuleridea* cf. *derooi* DAMOTTE & GROSDIDIER, 1963**
(Pl. 2, figs. 19-20)

1963b - *Schuleridea derooi*, DAMOTTE & GROSDIDIER: Ostr. Crét. inf. Champagne. II. Aptien, p. 154, pl. 1, fig. 4a-i.

Remarks. The material studied consists of relatively well-preserved carapaces and valves, on which some basic diagnostic features are visible: Compression of the front of the valves and of the ocular area in dorsal view, marked convexity of the ventral region on the LV. The original figures show no spines. Other specimens with antero- and postero- ventral spines have been figured (DAMOTTE & MAGNIEZ-JANNIN, 1973), which is also the case in the Aptian of the Jura (SAUVAGNAT, 1999) and in our material (see Pl. 2, figs. 18 & 20). These spine-bearing forms resemble *S. jonesiana*. Because of valve volume and shorter outline we propose to refer these specimens to *Schuleridea derooi*. Finally, it is probable that the illustrations of *S. derooi* (in KAYE & BARKER, 1965) are those of a different species.

Distribution: Upper Bedoulian of Pichouraz, rare in the lower Gargasian of Les Gays 1. Lower Aptian of the Paris Basin, Jura, Portugal (Extremadura). Middle-Upper Aptian of England, Ireland, Germany.

Subfamily CYTHERIDEINAE SARS, 1925
Genus *Dolocytheridea* TRIEBEL, 1938
Subgenus *Parasternbergella* GRÜNDEL, 1971
***Dolocytheridea* (*Parasternbergella*)**
***intermedia* OERTLI, 1958**
(Pl. 3, figs. 1-5)

1958 - *Dolocytheridea intermedia*, OERTLI: Ostr. Apt. Alb. Apt., p. 1505, pl. III, figs. 63-74; pl. IV, figs. 75-82.

1963 - *Dolocytheridea intermedia* OERTLI - OERTLI: Ostr. Mésoz. France, pl. 66, 2 and 67, 1.
 ? 1963b - *Dolocytheridea* cf. *bosquetiana* (JONES & HINDE) - KAYE: Interpret. Mesoz. Ostr. p. 33, pl. 3, figs. 15-16.

1971 - *Dolocytheridea* (*Parasternbergella*) *intermedia* OERTLI - GRÜNDEL: Taxon. V. Entwicklung *Cytheridea*, p. 29.

1981 - *Dolocytheridea* (*Parasternbergella*) *intermedia* OERTLI - COLIN *et alii*: Jur. Cret. Ostr. Southern Ireland, pl. 11.1, fig. 3.

1985 - *Dolocytheridea* (*Parasternbergella*) *intermedia* OERTLI - BABINOT *et alii*: Atlas Ostr. France, pl. 48, figs. 8-9.

1986 - *Dolocytheridea* (*Parasternbergella*) *intermedia* OERTLI - AINSWORTH: Ostr. Fasnet Basin, p. 154, pl. 1, fig. 8.

Remarks. Thanks to the excellent preservation of the material, we can attribute the numerous specimens available to the subgenus *Parasternbergella*, which is characterized by a merodont hinge with no subdivisions of its elements. Their assignment to the species *intermedia* (originally described from Gargas, near La Tuilière) is also confirmed.

Distribution: Lower Gargasian of Les Gays 1 and 2 Gargasian of Gargas (Vaucluse). Aptian of England and Ireland.

Subgenus *Puracytheridea* GRÜNDEL, 1971
***Doloccytheridea (Puracytheridea) aff. bosquetiana* (JONES & HINDE, 1890)**
(Pl. 3, fig. 6)

1849 - *Bairdia angusta* (VON MÜNSTER) - JONES: Entom. Cret. England, p. 26, pl. 6, fig. 18.

1890 - *Pontocypris bosquetiana*, JONES & HINDE: Suppl. Cret. Entom., p. 4, pl. 2, fig. 65; pl. 4, fig. 3.

1956 - *Doloccytheridea bosquetiana* (JONES & HINDE) - MERTENS: Alb/Cen. NW Deutschland, p. 196, pl. 10, figs. 45-47.

Remarks. We cannot confirm that our specimens belong to the subgenus *Puracytheridea*. The material is too rare, but nevertheless has the same specific features. The figured specimen (Pl. 3, fig. 6) is presumably that of a female.

Distribution: Lower Gargasian of Les Gays 1. Middle Albian-Lower Cenomanian of France, England, Ireland Germany, the Netherlands, Poland, northern Spain.

***Doloccytheridea* ? sp.**
(Pl. 3, fig. 7)

Remarks. The one valve resembles in outline the genus *Pontocyprilla*, but the "bairdioid" aspect typical of this genus is not displayed. The elements of the hinge are more like those of *Doloccytheridea*.

Distribution: Lower Gargasian of Les Gays 1.

Family CYTHERURIDAE MÜLLER, 1894
Subfamily PARACYTHERIDEINAE PURI,
1957 (sensu GRÜNDEL, 1975)
Genus *Parataxodonta* MANDELSTAM, 1956
***Parataxodonta inornata* (KAYE, 1965)**
(Pl. 3, figs. 18-25)

1958 - n.g. X, n. sp. 1, OERTLI: Ostr. Apt. Alb. Apt, p. 1508, pl. IV, figs. 100-104.

1965b - *Orthonotacythere inornata*, KAYE: Ostr. Apt. Isle of Wight, p. 41, pl. 6, fig. 11.

1985 - *Parataxodonta uralensis* MANDELSTAM -

BABINOT *et alii*: Atlas Ostr. France, pl. 49, fig. 4a-b.

1995 - *Parataxodonta inornata* (KAYE) - KEMPER; Ostr. Apt. NW Deutschlands, pl. 8, figs. 2, 9.

Remarks. The genus *Parataxodonta* was described in the Aptian-Albian of Kazakhstan with the generotype being *P. uralensis* MANDELSTAM, 1956. The author classed this genus in the Protocytherinae. This classification is also that of the Treatise on Invertebrate Paleontology (MOORE, 1961), but with reservations. The new material at our disposition permits us to assign without question this form (originally described and illustrated in open nomenclature by OERTLI, 1958) to the Upper Aptian species of the Isle of Wight, described under the name *Orthonotacythere inornata* (KAYE, 1965b). Detailed examination of the hinge (see Pl. 3, figs. 19, 20, 20a) shows that it is intermediate between adont / prionodont (a single cardinal element in relief along the DM, entirely crenulated) and holomerodont (in the RV the arrangement is the same, but the teeth hardly project). Such a pattern is that of the genus *Parataxodonta* (see original figures in MANDELSTAM, 1956). In the genus *Orthonotacythere* the dental reliefs are much more clearly differentiated. Classifying this species in the genus *Parataxodonta* had already been proposed under the name "*P. mandelstami* n. sp." (MOULLADE, 1965), but with no figures (consequently a *nomen nudum*).

A specific attribution for this taxon is much easier now, thanks to the abundance and excellent preservation of our material. The DM is rectilinear to slightly concave, the PM is very pointed and ends at the level of the DM and is connected to the VM by a regularly convex curve; two vertical excrescences occupy the forward half of the sides, bounding a flattened sulcus. All these features are smooth. KEMPER's (1995) illustrations are exactly like ours. And lastly, there is a strong sexual dimorphism, the supposed males being longer and narrower than the females.

Distribution: Exclusively in the lower Gargasian of Les Gays (top of the *Luterbacheri* Zone and the entire *Ferreolensis* Zone). "Aptian - Lower Albian" of the Gargas Hill (OERTLI, 1958 and material from the GIROUD-D'ARGOUD and MASSE collection, Marseilles). Gargasian of Gargas (MOULLADE, 1965), of the Pas d'Ouillier (W. La Bédoule) and from

Gignac-La-Nerthe (Rebuty) (between Marseilles and Martigues). Upper Aptian of the Isle of Wight (England). Middle-Upper Aptian of northern Germany.

Genus *Paranotacythere* BASSIOUNI, 1974
***Paranotacythere catalaunica* (DAMOTTE & GROSDIDIER, 1963)**
(Pl. 4, figs. 1-5)

? 1954 - *Orthonotacythere inversa* (CORNUEL) - STCHEPINSKY: Ostr. Crét. Haute- Marne, p. 496, pl. 22, fig. 1; text.pl. IV, fig. 26.

1963b - *Orthonotacythere catalaunica*, DAMOTTE & GROSDIDIER: Ostr. Crét. Inf. Champagne humide. II. Aptien, p. 159, pl. 3, fig. 13a-i.

1965b - *Orthonotacythere catalaunica* DAMOTTE & GROSDIDIER - KAYE, Ostr. Apt. Isle Wight, p. 40, pl. 8, figs. 9-10.

Remarks. Although they are not discussed in the text of the original description, the relationships of this species with the other members of the genus have been analyzed, thanks to the excellent plates of photographs (NEALE, *in* BATE & ROBINSON, 1978) for England as well as in the voluminous work of revision by BASSIOUNI (1974) on the genus *Paranotacythere*. This author puts the species *catalaunica* in synonymy with *P. inversa tuberculata* (KAYE, 1963), a disputable opinion because the general form and certain details of the ornamentation are different. *Orthonotacythere inversa* (CORNUEL), inserted in the list of synonyms of *P. catalaunica*, has been revised under the name *Paranotacythere (P.) inversa inversa* (CORNUEL) (BASSIOUNI, 1974). *P. choyensis* SAUVAGNAT, 1999 of the Middle Albian of the Jura has a slightly different ornamentation, is narrower, with the postero-ventral margin flattened and smooth.

Distribution: Lower Aptian of Les Gays 1 and 2. Lower Aptian of the Paris Basin (Champagne) and of the Isle de Wight (England).

Genus *Pedellacythere* GRÜNDEL, 1975
Pedellacythere* sp. aff. *pitstonensis
(WEAVER, 1982)
(Pl. 5, figs. 17-20)

1982 - *Pedicythere pitstonensis*, WEAVER: Ostr. Brit. Lower Chalk, p. 93, pl. 17, figs. 19-21.

Remarks. This small species (length not more than 0.4 mm) with very flattened valves and a long, spine-like, ventral wing can be compared to several species attributed to the genus *Pedicythere* EAGAR,

1965 and that GRÜNDEL (1975a) placed in his new genus *Pedellacythere*, according to certain cardinal and morphologic characteristics. This revision concerns Mesozoic species mainly.

Our few specimens are very similar to *P. pitstonensis* (WEAVER, 1982), but differ in that an antero-dorsal lobe is less marked, a postero-dorsal expansion is lower and the ventral spiniform wing is less rearwardly oriented. *P. fluitans* (BONNEMA, 1941) of the Maastrichtian of the Netherlands and ? *Stillina* cf. *fluitans* BONNEMA, 1941 (*in* KAYE & BARKER, 1965) of the Aptian of Lincolnshire have an arched DM and the line of spines fringing the AM is more in relief.

Distribution: Lower Gargasian of Les Gays 1 and 2. Lower Cenomanian of England.

Subfamily CYTHEROPTERINAE HANAI, 1957
Genus *Cytheropteron* SARS, 1866
***Cytheropteron* sp. aff. *nanissimum* DAMOTTE & GROSDIDIER, 1963**
(Pl. 4, fig. 6)

1963a - *Cytheropteron nanissimum*, DAMOTTE & GROSDIDIER: Ostr. Crét. inf. Champagne. I. Albien-Cénomanien, p. 56, pl. 1, fig. 2a-f.

Remarks. Very rare (two specimens in our material); this small species has the characteristics of the genus. The specific determination is still provisional.

Distribution: Lower Gargasian of Les Gays 1 and 2.

Genus *Eocytheropteron* ALEXANDER, 1933
***Eocytheropteron stchepinskyi* DAMOTTE & GROSDIDIER, 1963**
(Pl. 4, fig. 7)

1963b - *Eocytheropteron stchepinskyi*, DAMOTTE & GROSDIDIER: Ostr. Crét. inf. Champagne. II. Aptien, p. 159, pl. 2, fig. 11a-i.

Remarks. We have only one valve, figured here, that presents the morphologic traits and ornamentation of this species described from the Lower Aptian of Champagne. *E. nova reticulata* KAYE & BARKER, 1965 is larger, with a broader ventral overlapping, a similar but more vigorous system of reticulation and costulae, particularly on the level of the series of meshes bordering the VM.

Distribution: Lower Gargasian of Les Gays 1 and 2 (sample 2345). Lower Aptian of the Paris Basin, the Jura and the Isle of Wight (England).

Subfamily EUCYTHERURINAE PURI, 1974,
emend. MADDOCKS & STEINECK, 1987
Genus *Phodeucythere* GRÜNDEL, 1978
Phodeucythere cf. *trigonalis* (JONES &
 HINDE, 1890)
 (Pl. 3, fig. 8)

1890 - *Pontocypris trigonalis*, JONES & HINDE: Suppl. Cret. Entom., p. 3, pl. 3, figs. 25-26; pl. 4, figs. 1-2.

1981 - *Phodeucythere trigonalis* JONES & HINDE - COLIN *et alii*: Cret. Jur. N. Celtic Sea, pl. 1.1, fig. 7.

Remarks. Triangular shape conforming with that of the genus; small and smooth. Material, only one specimen (a carapace) similar to *P. trigonalis* but with the PM more rounded

Distribution: Lower Gargasian of Les Gays 1 (sample 2326). Aptian-Albian of England, Germany, the Netherlands, Poland, Albian of the Jura.

Genus *Microceratina* SWANSON, 1980
Microceratina ? sp.
 (Pl. 6, fig. 19)

Remarks. Described originally from New Zealand, this genus is reduced to around ten species, of which nine are distributed from Miocene to Recent, and one older one in the Maastrichtian of the island of Rügen (HERRIG, 1966; MAZZINI & GLIOZZI, 2000). Knowledge has improved thanks to the discovery of forms of Tethyan origin in the Upper Jurassic of Libya and the Cenomanian of Morocco (COLIN *et alii*, 2005). These authors made a detailed analysis of the bibliography of species morphologically referable to this genus; the major criterion for their recognition is the existence of groups of pores ("en meurtrière" = loophole-like, "en fente" = split-like) in the meshes of the reticulum.

We have only one carapace with the characteristics of this genus, but could not observe the details of the microstructure of the reticulum.

Distribution: Lower Gargasian of Les Gays 1.

Genus *Chapmanicytherura* WEAVER, 1982
Chapmanicytherura cf. *kaye* WEAVER, 1982
 (Pl. 6, fig. 18)

1965a - *Eucytherura* aff. *nuda* KAYE - KAYE: New Brit. Alb. Ostr., p. 231, pl. 7, figs. 17-18.

1973 - ? *Eucytherura* aff. *nuda* KAYE - COLIN: Nouv. Contr. Ostr. Crét. sup. Dordogne, p. 26,

pl. 5, fig. 12.

1982 - *Chapmanicytherura kayei*, WEAVER: Ostr. Lower Chalk, p. 85, pl. 16, figs. 1-4.

Remarks. Our material is comprised of only one carapace that can be referred to this species. It is ornamented with the characteristic, bulb-shaped nodes. The genus *Chapmanicytherura* may be a synonym of *Microceratina*, but *C. kayei* should not be attached to this genus according to COLIN *et alii* (2005, p. 19). Other forms are very close, like *Eucytherura* aff. *nuda* KAYE, 1965 of the Albian of England and the Cenomanian of the Dordogne, France (COLIN, 1973). Taking these remarks into account, we leave this form provisionally in the genus *Chapmanicytherura*.

Distribution: Lower Gargasian of La Tuilière W.

Family NEOCYTHERIDAE WILKINSON, 1988
Genus *Neocythere* MERTENS, 1956

The genera *Neocythere* and *Centrocythere*, created by MERTENS in 1956, as well as the genus *Physocythere* GRÜNDEL, 1966, are very close morphologically. In an analysis, already old (KAYE, 1963c), the same phrase is used to begin the emended description of these three entities: "... carapace rounded, inflated, ventrally tumid"; in fact, their forms are quite identical. KAYE (1963c) considered these three forms to be subgenera: *N.* (*Neocythere*) with an amphidont hinge *N.* (*Physocythere*) with a merodont hinge, *N.* (*Centrocythere*) being distinguished by the structure of the anterior tooth of the RV. Added to these bases of discrimination are variations in the detail of the several elements along with the presence or absence of a dorsal "accommodation groove".

Subgenus *Neocythere* (*Centrocythere*)
MERTENS, 1956
Neocythere (*Centrocythere*) *gottisi*
 DAMOTTE & GROSDIDIER, 1963
 (Pl. 4, figs. 8-12)

1963b - *Centrocythere gottisi*, DAMOTTE & GROSDIDIER: Ostr. Crét. inf. Champagne, II. Aptien, p. 157, pl. 2, fig. 9a-i.

Remarks. A species whose constant presence in the upper Bedoulian of Pichouraz has a local value as an index fossil. The hinge (see Pl. 4, figs. 10, 12, 12a) corresponds well with the diagnosis of the subgenus *Centrocythere sensu* KAYE.

The valves have a straight or slightly convex DM and a PM a little below the mid point of the height; the ornamentation consists of concentric costulae, well defined and well separated on the periphery and in short segments in the central area of the valves where their disposition is anarchic. Almost identical configurations are shown (AINSWORTH, 1986) in a publication concerning the Aptian of the Fastnet basin, SW Ireland.

Distribution: Upper Bedoulian of Pichouraz. Lower Aptian of the Paris Basin, Jura, Southern England, Isle of Wight, off shore southern Ireland, Portugal.

Subgenus *Neocythere* (*Neocythere*)

MERTENS, 1956

***Neocythere* (*Neocythere*) *mertensi* OERTLI, 1958**

(Pl. 4, figs. 13-17)

1958 - *Neocythere mertensi*, OERTLI: Ostr. Apt. Alb. Apt, p. 1508, pl. V, figs. 114-122.

1985 - *Neocythere mertensi* OERTLI - BABINOT *et alii*: Atlas Ostr. France, pl. 49, fig. 2.

1995 - *Neocythere mertensi* OERTLI - KEMPER: Ostr. Apt NW Deutschlands, pl. 6, figs. 2-4, 7.

1998 - *Neocythere mertensi* OERTLI - BABINOT: Ostr. strat. hist. Cassis-La Bédoule, pl. 1, fig. 5.

Description: Valves ornamented with 3-4 large peripheral crests and a very dense reticulation in the center, with an elongate eye tubercle. The hinge (see Pl. 4, figs. 14, 16, 16a) is consistent with that of the subgenus with an anterior crenulated tooth (5 denticles) and a dorsal articulation groove for the LV. The type material (OERTLI, 1958) comes from the Gargas Hill, so a little higher stratigraphically than that of our material.

Distribution: Last beds of the lower Gargasian of Les Gays 2. Gargasian of the Gargas Hill. Lower-Middle Aptian of northern Germany.

Family PROTOCYTHERIDAE LJUBIMOVA, 1955

Subfamily PROTOCYTHERINAE LJUBIMOVA, 1955

Genus *Protocythere* TRIEBEL, 1938

***Protocythere bedoulensis* MOULLADE, 1963 (Pl. 4, figs. 18-23)**

1963 - *Protocythere bedoulensis*, MOULLADE: Genre *Protocythere* Crét. inf. S.E. France, p. 102, pl. I, figs. 1-6.

1984 - *Protocythere bedoulensis* MOULLADE - SCARENZI-CARBONI: Ostr. Bassin vocontien, pl. 6, fig. 3.

1985 - *Protocythere bedoulensis* MOULLADE -

BABINOT *et alii*: Atlas Ostr. France, pl. 49, fig. 1.
1998 - *Protocythere bedoulensis* MOULLADE - BABINOT: Ostr. strat. hist. Cassis-La Bédoule, pl. 1, figs. 6-10.

Remarks. This large, easily recognizable species is present in abundance in all of the upper Bedoulian samples from Pichouraz. It disappears abruptly at the limit with the lower Gargasian. There is no additional information to bring to the original description, except the presence on many individuals of some short spines on the ventral slope of the PM which in any case were drawn in the original illustrations by the author of the species (MOULLADE, 1963).

Distribution: Upper Bedoulian of Pichouraz and of the La Tuilière W sections. Bedoulian of Cassis-La Bédoule (stratotype) and of the Vocontian Basin (Drôme, Ardèche). This species may be present as of the Hauterivian-Barremian in Bulgaria (com. P. DONZE). It has also been found in the Upper Hauterivian and Lower Barremian of Morocco (ROSSI & MALZ, 2005; ROSSI, 2006), in the Gargasian-Clansayesian of Morocco (ANDREU-BOUSSUT, 1991) and also in the Aptian of Ecuador (com. J.-P. COLIN).

Genus *Hechtcythere* GRÜNDEL, 1974

***Hechtcythere derooi* (OERTLI, 1958) (Pl. 5, figs. 1-5)**

1958 - *Protocythere derooi*, OERTLI: Ostr. Apt. Alb. Apt, p. 1509, pl. VI, figs. 129-143.

1974 - *Hechtcythere derooi* (OERTLI) - GRÜNDEL: Taxon. Phyl. Cytherettidae, p. 84.

Remarks. The genus *Hechtcythere* is characterized by the trace of three longitudinal ridges, together forming a kind of Z. On the LV of *H. derooi* there is a subvertical swelling that unites the dorsal and median ridges a little back of the middle, a detail not reported in the original description (see Pl. 5, figs. 1-2). This species is close to *H. alexanderi* HOWE & LAURENCICH, 1958 from the Grayson Marls (Albian) of Texas (direct comparison made with the help of topotypes [MOULLADE collection] authenticated by HOWE). But as OERTLI (1958) had already reported *H. alexanderi* is more elongate, the PM is more pointed, the ridges are less inflated. Very rare and poorly preserved individuals from the Bedoulian of La Bédoule were referred to *H. alexanderi* (BABINOT, 1998) but this determination is questionable.

Distribution: Upper Bedoulian of

Pichouraz and Lower Gargasian of Les Gays 1. Aptian-Albian of the Paris Basin, the Jura. Upper Barremian-Aptian of Ireland (southern offshore). Lower Aptian of northern Germany. Upper Aptian of England and the Isle of Wight. Aptian of Spain, Venezuela (COLIN & BABINOT, 1993).

***Hechtythere* cf. *derooi* (OERTLI, 1958)**
(Pl. 5, figs. 6-11)

Remarks. This form, relatively abundant in our material, has been collected only from the upper Bedoulian. In many ways it is closely analogous to *H. derooi*, notably in the trace and volume of the lateral ridges, but it is smaller, the PM more acuminate, the hinge less well developed, and the marginal zones are very narrow. *H. croutesensis* (DAMOTTE & GROSDIDIER, 1963) from the Lower Aptian of Champagne is close, but differs in a more elongate and narrower silhouette, an AM that is more curved at the ventral level, the absence of a frontal lobe in the RV, a very long dorsal ridge that continues past the eye tubercle. The examination of individuals collected from the Lower Aptian of Jura (gift of SAUVAGNAT in the BABINOT collection) confirms these differences.

Consequently, a hypothesis can be formulated that this material may represent juvenile specimens of *H. derooi*.

Distribution: Upper Bedoulian of Pichouraz.

Genus *Saxocythere* KEMPER, 1971
***Saxocythere tenuissima* KEMPER, 1971**
(Pl. 5, figs. 12-15)

1971 - *Saxocythere tenuissima*, KEMPER: *Batavocythere* u. *Saxocythere*, p. 402, pl. 3, figs. 3-9.

Remarks. The criteria for the generic attribution of this form are based on hinge elements, and at the species level on the characteristics of the lateral ridges. The hinge of the RV (Pl. 4, fig. 14a) shows a modification toward the extremities of an antimerodont hinge (see the original diagnosis in KEMPER, 1971). The ridges are very narrow, pointed (in particular the middle ridge is a little constricted in the middle), the eye tubercle is weakly conspicuous, the PM stretched out and pointed; there is always a swelling below the frontal lobe. A direct comparison with KEMPER's type material (kindly provided by F.W. LUPPOLD, Hannover) shows without

ambiguity that our material is identical to that from Germany.

Distribution: Lower Gargasian of Les Gays 1 and 2. Lower part of the Upper Aptian of Germany (East of Rheine, Lower Saxony).

Family TRACHYLEBERIDIDAE SYLVESTER-BRADLEY, 1948

Subfamily TRACHYLEBERIDINAE SYLVESTER-BRADLEY, 1948

Genus *Parexophthalmocythere* OERTLI, 1959

Subgenus *Parexophthalmocythere* OERTLI, 1959

Parexophthalmocythere
(*Parexophthalmocythere*) sp.
(Pl. 6, figs. 2-9)

Description: Small species (maximum length 0.45 mm). DM and VM strongly convergent toward the posterior end. AM marked by a line-up of 15 spines of variable shapes, bounding an anterior area that is smooth and flat. The PM has a convex spiny ventral slope, the concave dorsal portion passing with a sharp bend to the DM. The side is divided into two irregularly swollen areas separated by a vertical depression. The entire surface is very finely reticulate and is ornamented by tubercles of variable size and by spines (apparently hollow, or pore conuli). A very prominent eye tubercle is a characteristic of this genus. The side broadens ventrally and extends past the VM in a sort of wing like a keel. The hinge is of a merodont type, so conforms to the revised diagnosis of the subgenus (GRÜNDEL, 1975b), with a widely open ocular sinus.

Our material is sparse and the measurements obtained are probably those of juvenile stages. Undoubtedly this is a new form, but without adults it would be unwise to create a new species.

The species attributed to the genus *Parexophthalmocythere* are few in number (see the KEMPF index, 1986) and all have been listed from the Lower Cretaceous. On the other hand, the subgenus *Amphioxophthalmocythere* GRÜNDEL, 1975 ranges up to the Cenomanian.

The species nearest to ours is *P. rodewaldensis* BARTENSTEIN & BRAND, 1959 from the Hauterivian of Germany, but it is more elongated, the distal spines are stronger and there is no ventral keel. *P. spinosa* BARTENSTEIN & BRAND, 1959 from the Valanginian has simpler ornamen-

tation. Finally, *P. berriasensis* DONZE, 1965 from the Lower Valanginian of the Ardèche is very narrow and differs in the details of ornamentation.

Distribution: Uppermost beds of the upper Bedoulian and the first levels of the Lower Gargasian of Pichouraz and La Tuilière W. Consequently, it is a species to be considered as a possible local marker of the transition between the two substages

Genus *Cornicythereis* GRÜNDEL, 1973
***Cornicythereis gatyensis* (DAMOTTE & GROSIDIER, 1963)**
(Pl. 5, fig. 16)

1963a - *Cythereis* ? *gatyensis*, DAMOTTE & GROSIDIER: Ostr. Crét. inf. Champagne. I. Albien-Cénomanién, p. 58, pl. 3, fig. 8a-g.

1973 - *Cornicythereis gatyensis* (DAMOTTE & GROSIDIER) - GRÜNDEL: Zur Entwicklung Trachyleberididae, p. 1471.

Remarks. According to the very complete list of synonyms established by SAUVAGNAT (1999) it appears that this species has often been confused with *C. cornuelli* (DEROO, 1957) and *C. lamplughii* (KAYE, 1963). *C. gatyensis* has an irregular dorsal excrescence, but it is uninterrupted and the median ridge is "clearly separated from the central muscle tubercle". We see this feature on the only specimen available in our material.

Distribution: Base of the Pichouraz section (upper Bedoulian). Lower Aptian-Middle Albien of the Paris Basin, the Jura, England, Ireland, Germany.

Genus *Platycythereis* TRIEBEL, 1940
***Platycythereis rectangularis* OERTLI, 1958**
(Pl. 5, figs. 21-23)

1958 - *Platycythereis rectangularis*, OERTLI: Ostr. Apt. Alb. Apt, p. 1515, pl. VIII, fig. 183-194.

1973 - *Chapmanicythereis rectangularis* (OERTLI) - GRÜNDEL: Zur Entwicklung Trachyleberididae, p. 1473.

1985 - *Platycythereis rectangularis* OERTLI - BABINOT *et alii*: pl. 48, fig. 10.

Remarks. Our specimens are very like those of the original figures. At the genus level we reject its attribution to *Chapmanicythereis*, as proposed by GRÜNDEL (1973). Indeed, that genus is characterized by a peripheral ridge in marked relief, but this structure does not exist on the specimens in our material. So we confirm and retain the original generic attribution.

Distribution: A form rare and scattered throughout all of the sections of La Tuilière sector. Found recently in the "Aptian" of the Gard (G. CONTE's material in the BABINOT collection).

***Platycythereis* sp.**
(Pl. 5, fig. 24; Pl. 6, fig. 1)

Remarks. Specimens smaller than those of the preceding species, with no peripheral ridge or an oblique median rib, and with no spines on the antero-ventral edge. These sparse, poorly preserved forms are perhaps juvenile stages of *P. rectangularis*. We leave them in open nomenclature.

Distribution: All the sections in La Tuilière sector.

Genus *Rehacythereis* GRÜNDEL, 1973
***Rehacythereis buechlerae* (OERTLI, 1958)**
(Pl. 6, figs. 10-14)

1958 - *Cythereis buechlerae*, OERTLI: Ostr. Apt. Alb. Apt, p. 1512, pl. VII, figs. 153-169; pl. IX, figs. 195-196.

1973 - *Rehacythereis buechlerae* (OERTLI) - GRÜNDEL: Zur Entwicklung Trachyleberididae, p. 1408.

1985 - *Rehacythereis buechlerae* (OERTLI) - BABINOT *et alii*: pl. 49, fig. 6.

Remarks. An easily recognized species, abundant in many Aptian beds of south-eastern France. In the material studied here, its first occurrence is in the *Ferrolensis* Zone of the Lower Gargasian. There is nothing to add to the original diagnosis-description, if it is only the placement of this form in the genus *Rehacythereis* (see the discussion in GRÜNDEL, 1973).

Distribution: Lower Gargasian of Les Gays 1 and 2. Gargasian of the Gargas Hill, Cassis-La Bédoule, Uzès (Gard). upper Gargasian of the Camp du Castellet (Var) and of the Mède (Bouches-du-Rhône).

***Rehacythereis* cf. *bartensteini* (OERTLI, 1958)**
(Pl. 6, fig. 15)

1958 - *Cythereis bartensteini*, OERTLI: Ostr. Apt. Alb. Apt, p. 1515, pl. VIII, figs. 183-194.

1973 - *Rehacythereis bartensteini* (OERTLI) - GRÜNDEL: Zur Entwicklung Trachyleberididae, p. 1408.

1985 - *Rehacythereis bartensteini* (OERTLI) - BABINOT *et alii*: pl. 49, fig. 5.

Remarks. Our material is limited to a single juvenile RV from the top of the Les Gays 2 section (upper part of the

Ferreolensis Zone), but the determination is uncertain. Adult specimens from the Gargas Hill that may be considered topotypes have been figured here as supplementary information (see Pl. 6, figs. 16-17) (J.-P. MASSE's and G. GIROUD-D'ARGOUD's material in the BABINOT collection).

Conclusions

The detailed analysis of the microfaunas of Ostracoda in the Saturnin-lès-Apt (La Tuilière) sector has improved significantly our knowledge of the micropaleontologic content of a geologic reference area, the stratotype of the Aptian stage in the Apt region. More precisely, this new contribution pertains to a poorly known part of the stage, that is the top of the upper Bedoulian (Lower Aptian) and the lower Gargasian. It made possible the correlation of an important number of species with the foraminiferal zonal scale. In addition to the forms already reported in the stratotype, a good number of species described in diverse regions of Western Europe have been identified and their stratigraphic range precised. The examination of the distributions makes it possible to characterize with precision the two substages by bringing to light that there are two groups with different compositions which succeed each other in time. However, the evolution of the Ostracod populations is perturbed by an episode of severe impoverishment dated at the base of the lower Gargasian. Numerous elements of the Ostracod fauna coexisted in a number of regions, thus indicating a relative homogeneity of Aptian microfaunas on the North Tethyan margins.

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Plate 1:

- 1-3 - *Cytherella* ex gr. *ovata* (ROEMER, 1841)
 1. C, left lateral view, Sample 2276
 2. RV, lateral view, Sample 2305
 3. C, dorsal view, Sample 2340
- 4 - *Cytherella* cf. *parallela* (REUSS, 1846)
 RV, lateral view, Sample 2342, paratype n° PAP 1/1
- 5-7 - *Cytherella circumrugosa* nov. sp.
 5. RV, lateral view, Sample 2342, paratype n° PAP 1/1
 6. LV, lateral view, Sample 2342, paratype n° PAP 1/2
 7. LV lateral view, Sample 2342, Holotype n° HAP 1
 7a. *idem*, detail of the anterior part
- 8-10 - *Cytherella* aff. *speetonensis* KAYE, 1963
 8. RV, lateral view, Sample 2338
 9. LV, lateral view, Sample 2284
 10. RV, lateral view, Sample 2290
- 11-14 - *Cytherelloidea bedouliana* nov. sp.
 11. RV, lateral view, Sample 2292, paratype n° PAP 2/1
 12. LV, lateral view, Sample 2300, paratype n° PAP 2/2
 13. RV, lateral view, Sample 2300, Holotype, n° HAP 2
 14. RV, dorsal view, Sample 2300, paratype PAP 2/3
- 15 - *Bythocypris* ? sp.
 C, left lateral view, Sample 2280
- 16 - *Polycope oweni* KAYE, 1965
 C, right lateral view, Sample 2303
- 17 - *Paracypris acuta* (CORNUEL, 1848)
 LV, left lateral view, Sample 2339
- 18-19 - *Macrocypris* ? sp. 2
 18. C, right lateral view, Sample 2346
 19. C, left lateral view, Sample 2359
- 20 - *Macrocypris* sp. 1
 C, right lateral view, Sample 2291

Plate caption

C = Complete shell, *i.e.* both valves
 RV = Right valve
 LV = Left valve
 AM = Anterior margin
 PM = Posterior margin
 DM = Dorsal margin
 VM = Ventral margin

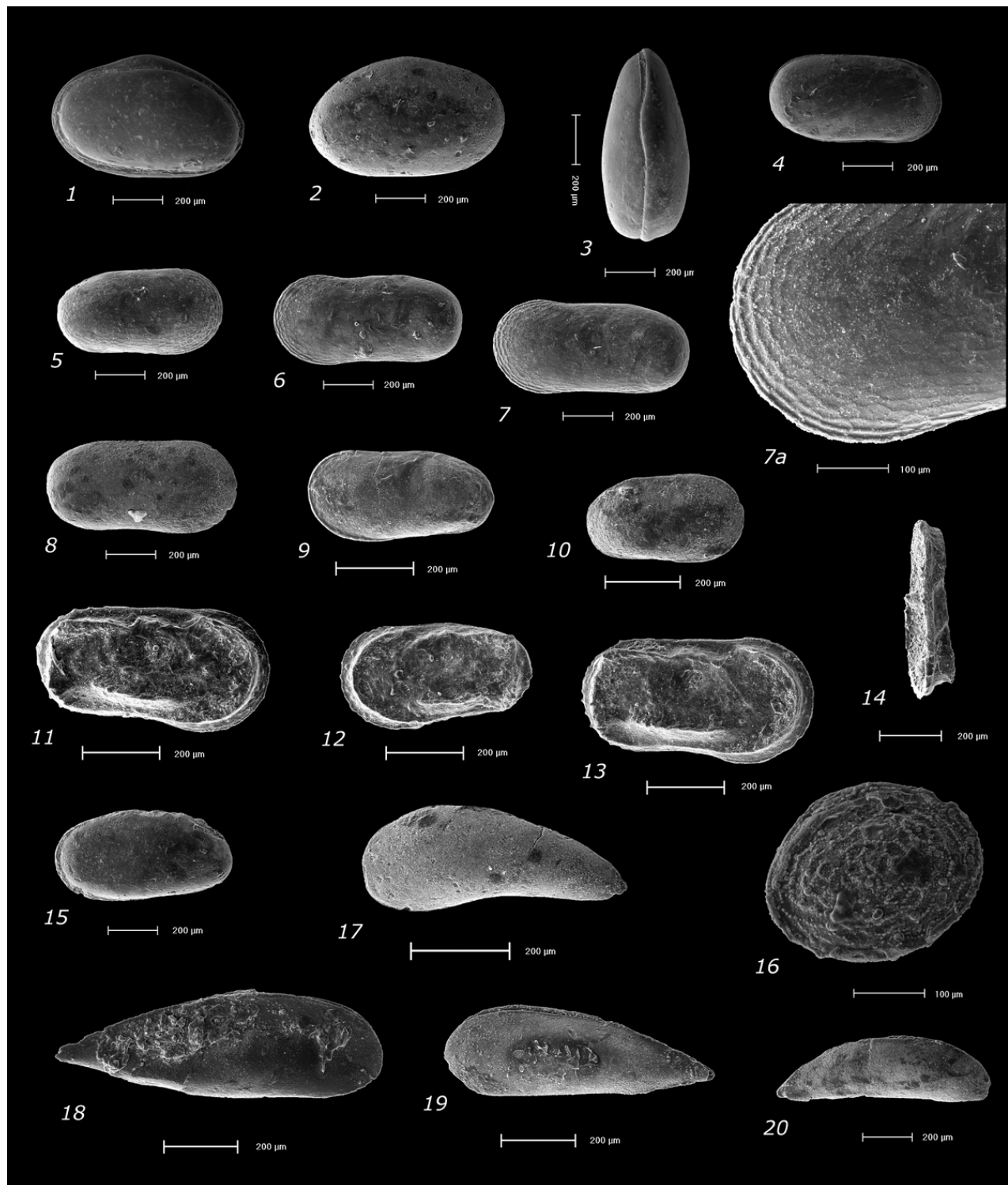


Plate 2:

- 1-3 - *Paracypris wrothamensis* KAYE, 1965
 - 1. LV, lateral view, Sample 2345
 - 2. RV, lateral view, Sample 2345
 - 3. C, right lateral view, Sample 2363
- 4 - *Patellacythere* sp.
 - C, right lateral view, Sample 2292
- 5 - *Bythoceratina* ? sp. 1
 - C, left lateral view, Sample 2366
- 6-8 - *Bythoceratina* (*Cuneoceratina*) *marginata* WEAVER, 1982
 - 6. LV, lateral view, Sample 2280
 - 7. C, left lateral view, Sample 2275
 - 8. RV, lateral view, Sample 2298
- 9-10 - *Bythoceratina* sp. 2
 - 9. RV, lateral view, Sample 2339
 - 10. LV, lateral view, Sample 2336
- 11-14 - *Dicrorygma minuta* (KAYE, 1963)
 - 11. RV, lateral view, Sample 2352
 - 12. LV, lateral view, Sample 2283
 - 13. RV, lateral view, Sample 2301
 - 14. RV, internal view, Sample 2301
- 15-17 - *Cardobairdia minuta* (VEEN, 1936)
 - 15. C, right lateral view, Sample 2344
 - 16. RV, internal view, Sample 2339
 - 16a. *idem*, detail of the hinge
 - 17. C, lateral view left, Sample 2344
- 18 - *Schuleridea jonesiana* (BOSQUET, 1852)
 - RV, lateral view, Sample 2284
- 19-20 - *Schuleridea* cf. *derooi* DAMOTTE & GROSDIDIER, 1963
 - 19. LV, lateral view, Sample 2270
 - 20. C, right lateral view, Sample 2279

Plate caption

C = Complete shell, *i.e.* both valves
 RV = Right valve
 LV = Left valve
 AM = Anterior margin
 PM = Posterior margin
 DM = Dorsal margin
 VM = Ventral margin

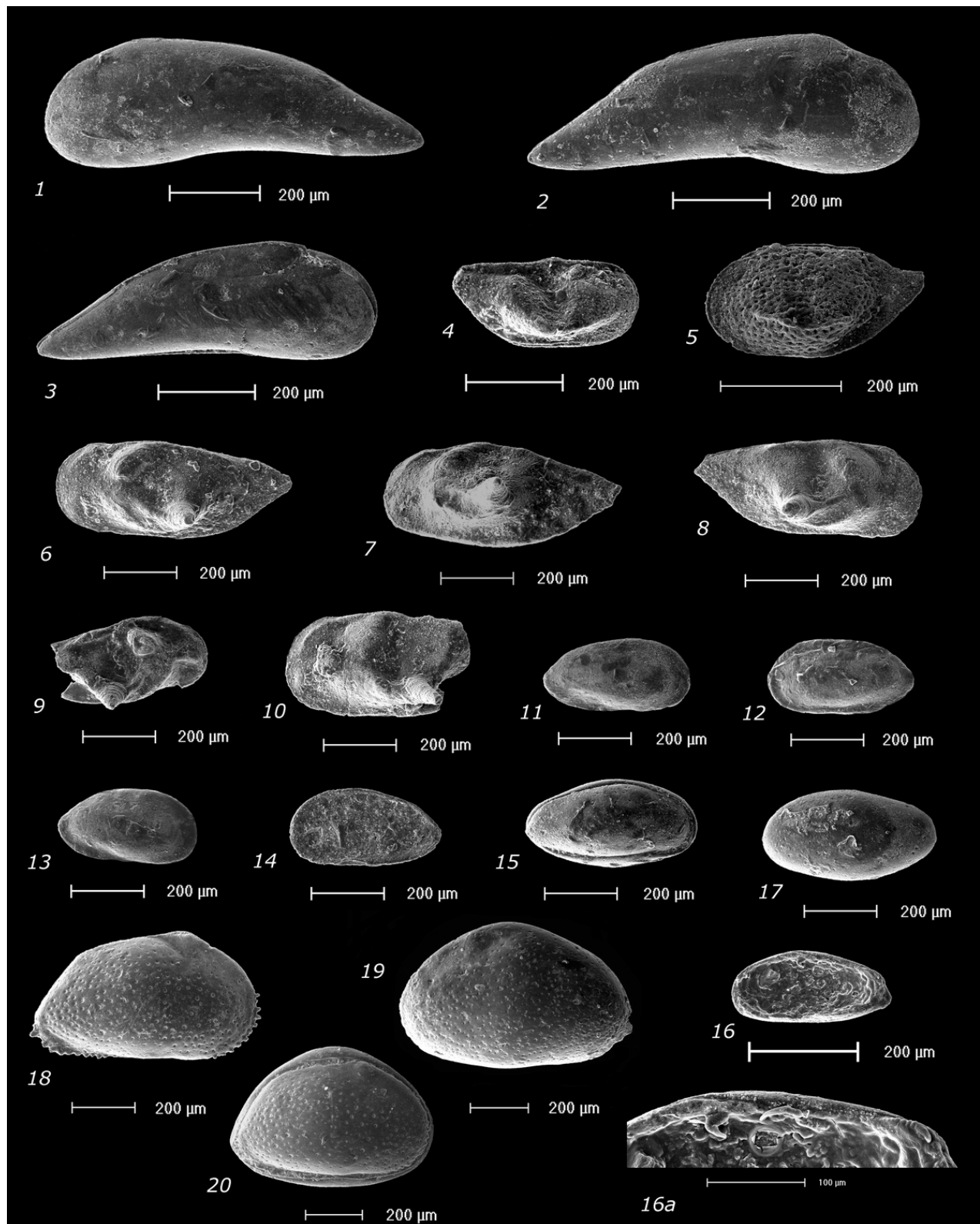


Plate 3:

- 1-5 - *Dolocytheridea* (*Parasternbergella*) *intermedia* OERTLI, 1958
 1. LV, lateral view, Sample 2342
 2. C, lateral view, Sample 2338
 3. LV, internal view, Sample 2364
 4. LV, internal view, Sample 2364
 5. RV, internal view, Sample 2342
- 6 - *Dolocytheridea* (*Puracytheridea*) aff. *bosquetiana* (JONES & HINDE, 1890)
RV, lateral view, Sample 2327
- 7 - *Dolocytheridea* ? sp.
LV, lateral view Sample 2327
- 8 - *Phodeucythere* cf. *trigonalis* (JONES & HINDE, 1890)
RV, lateral view Sample 2326
- 9-10 - *Pontocyprrella* sp. aff. *harrisiana* (JONES, 1849)
 9. C, left lateral view, Sample 2285
 10. C, right lateral view, Sample 2285
- 11-12 - *Pontocyprrella harrisiana* (JONES, 1849)
 11. LV, lateral view, Sample 2284
 12. RV, lateral view, Sample 2275
- 13-17 - *Pontocyprrella maynci* OERTLI, 1958
 13. LV, lateral view, Sample 2333
 14. RV, lateral view, Sample 1303
 15. RV, internal view, Sample 2332
 16. C, right lateral view, Sample 2332
 17. LV, internal view, Sample 2305
- 18-25 - *Parataxodonta inornata* (KAYE, 1965)
 18. RV, lateral view, Sample 2337
 19. LV, internal view, Sample 2341
 20. RV, internal view, Sample 2328
 - 20a. *idem*, detail of the hinge
 21. LV, internal view, Sample 2341
 22. RV female, lateral view, Sample 2337
 23. RV male, lateral view, Sample 2337
 24. C, dorsal view, Sample 2339
 25. LV juvenile specimen, lateral view, Sample 2329

Plate caption

C = Complete shell, *i.e.* both valves

RV = Right valve

LV = Left valve

AM = Anterior margin

PM = Posterior margin

DM = Dorsal margin

VM = Ventral margin

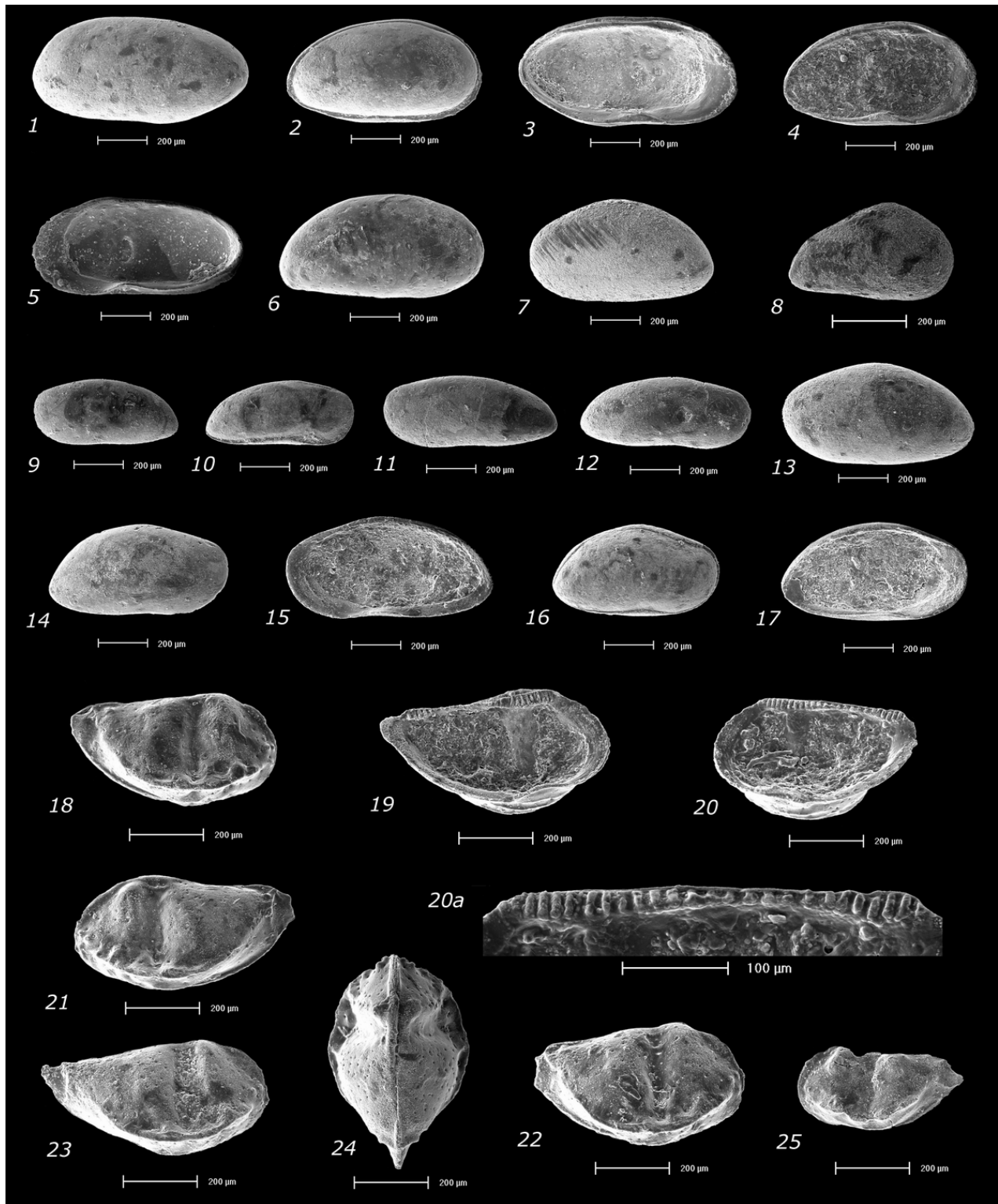


Plate 4:

- 1-5 - *Paranotacythere catalaunica* (DAMOTTE & GROSDIDIER, 1963)
 - 1. LV, lateral view, Sample 2338
 - 2. LV, lateral view, Sample 2338
 - 3. RV, lateral view, Sample 2344
 - 4. RV, internal view, Sample 2344
 - 5. LV, dorsal view, Sample 2338
- 6 - *Cytheropteron* sp. aff. *nanissimum* DAMOTTE & GROSDIDIER, 1963
 - LV, lateral view, Sample 2345
- 7 - *Eocytheropteron stchepinskyi* DAMOTTE & GROSDIDIER, 1963
 - LV, lateral view, Sample 2345
- 8-12 - *Neocythere (Centrocythere) gottisi* DAMOTTE & GROSDIDIER, 1963
 - 8. LV, lateral view, Sample 2275
 - 9. C, right lateral view, Sample 2275
 - 10. RV, internal view, Sample 2275
 - 10a. *idem*, detail of the hinge
 - 11. C, dorsal view, Sample 2276
 - 12. LV, internal view, Sample 2285
- 13-17 - *Neocythere (Neocythere) mertensi* OERTLI, 1958
 - 13. LV, lateral view, Sample 2301
 - 14. LV, internal view, Sample 2302
 - 15. C, dorsal view (juvenile specimen), Sample 2301
 - 16. RV, internal view, Sample 2302
 - 16a. *idem*, detail of the hinge
 - 17. LV, lateral view (juvenile specimen), Sample 2302
- 18-23 - *Protocythere bedoulensis* MOULLADE, 1963
 - 18. C, right lateral view, Sample 2292
 - 19. RV, internal view, Sample 2292
 - 20. LV, lateral view, Sample 2275
 - 21. RV, lateral view, Sample 2279
 - 22. LV, internal view, Sample 2293
 - 23. C, dorsal view, Sample 2279

Plate caption

C = Complete shell, *i.e.* both valves
 RV = Right valve
 LV = Left valve
 AM = Anterior margin
 PM = Posterior margin
 DM = Dorsal margin
 VM = Ventral margin

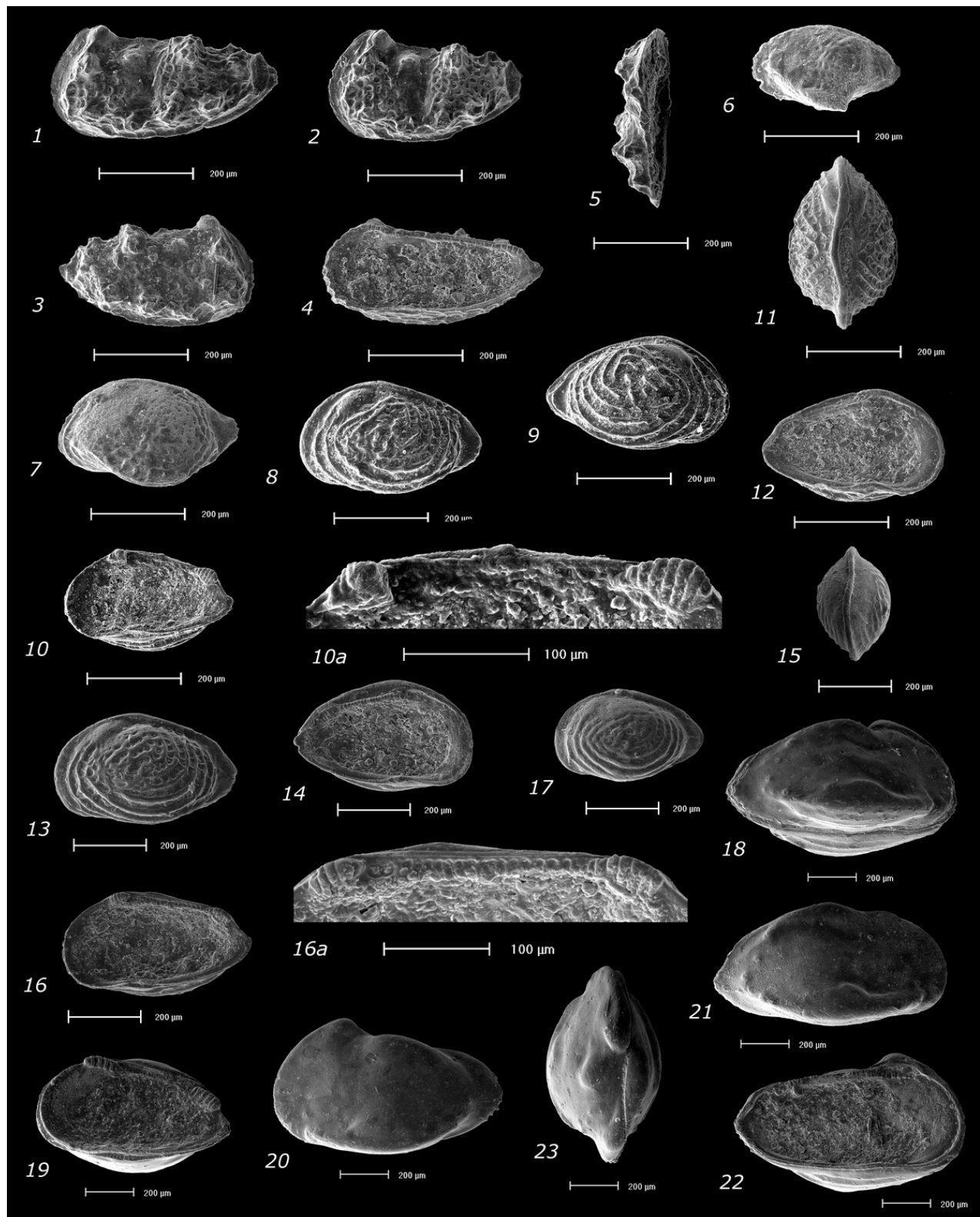


Plate 5:

- 1-5 - *Hechticythere derooi* (OERTLI, 1958)
 - 1. C, lateral view left, Sample 2271
 - 2. LV, lateral view, Sample 2298
 - 3. C, right lateral view, Sample 2298
 - 4. RV, lateral view, Sample 2298
 - 5. RV, internal view, Sample 2334
- 6-11 - *Hechticythere* sp. aff. *derooi* (OERTLI, 1958)
 - 6. LV, lateral view, Sample 2293
 - 7. LV, lateral view, Sample 2288
 - 8. RV, internal view, Sample 2327
 - 8a. *idem*, detail of the hinge
 - 9. LV, internal view, Sample 2288
 - 10. RV, lateral view, Sample 2300
 - 11. RV, dorsal view, Sample 2293
- 12-15 - *Saxocythere tenuissima* KEMPER, 1971
 - 12. RV, lateral view, Sample 2345
 - 13. LV, lateral view, Sample 2334
 - 14. RV, internal view, Sample 2334
 - 14a. *idem*, detail of the hinge
 - 15. RV, lateral view, Sample 2334
- 16 - *Cornicythereis gatyensis* DAMOTTE & GROSDIDIER, 1963
 - C, left lateral view, Sample 2270
- 17-20. - *Pedellacythere* aff. *pitstonensis* (WEAVER, 1982)
 - 17. LV, lateral view, Sample 2346
 - 18. RV, lateral view, Sample 2302
 - 19. LV, dorsal view, Sample 2336
 - 20. LV, lateral view, Sample 2335
- 21-23 - *Platycythereis rectangularis* OERTLI, 1958
 - 21. RV, lateral view, Sample 2283
 - 22. RV, lateral view, Sample 2328
 - 23. LV, lateral view, Sample 2298
- 24 - *Platycythereis* sp.
 - RV, lateral view, Sample 2292

Plate caption

C = Complete shell, *i.e.* both valves

RV = Right valve

LV = Left valve

AM = Anterior margin

PM = Posterior margin

DM = Dorsal margin

VM = Ventral margin

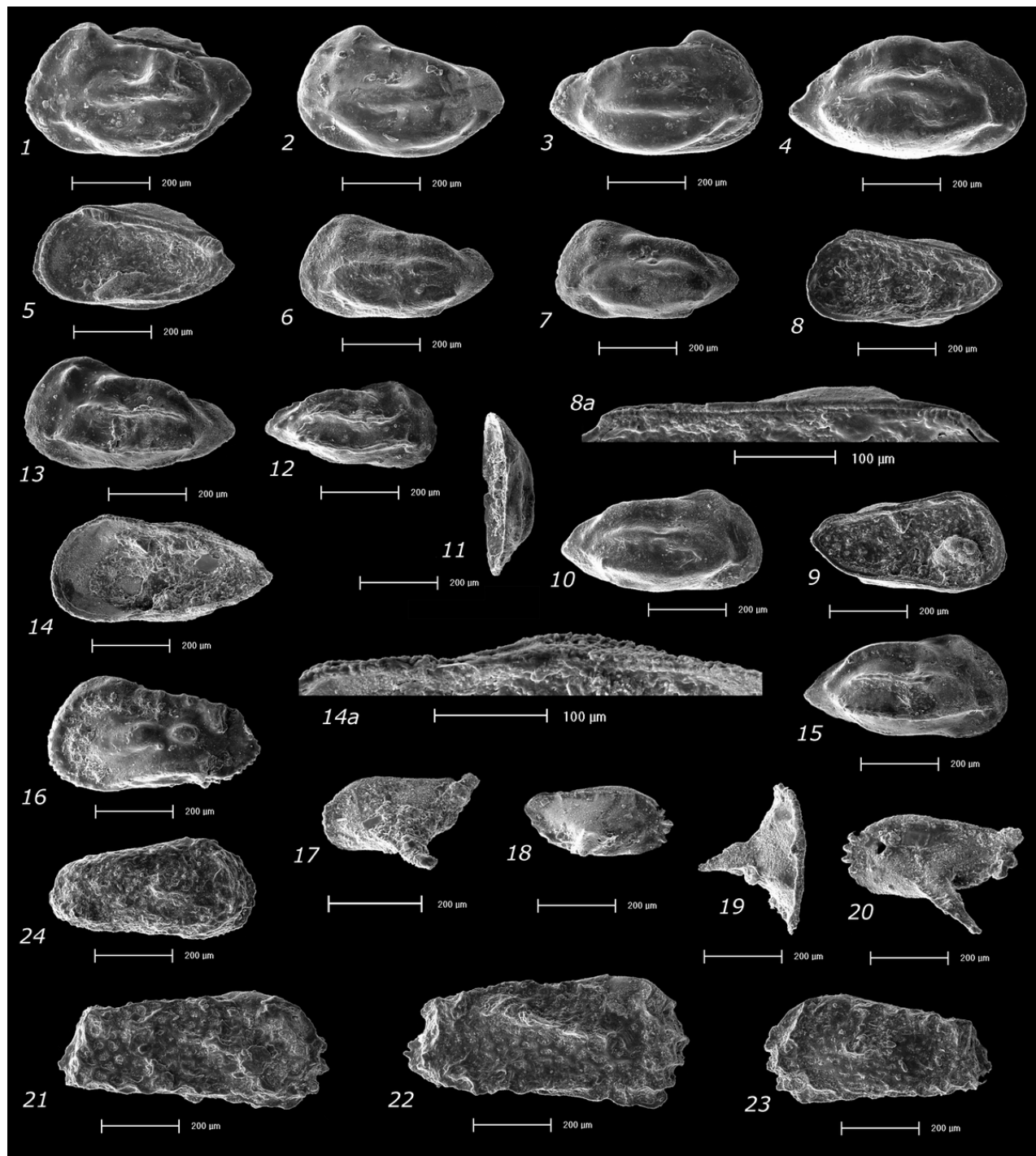


Plate 6:

- 1 - *Platycythereis* sp.
LV, lateral view, Sample 2292
- 2-9 - *Parexophthalmocythere* (*Parexophthalmocythere*) sp.
 2. RV, lateral view Sample 2362
 3. RV, lateral view, Sample 2368
 4. RV, internal view, Sample 2368
 5. LV, lateral view, Sample 2355
 6. LV, internal view (fragment), Sample 2368
 7. LV, internal view, Sample 2368
 8. RV, lateral view, Sample 2351
 9. LV, lateral view, Sample 2368
- 10-14 - *Rehacythereis buechlerae* (OERTLI, 1958)
 10. LV, lateral view, Sample 2336
 11. LV, lateral view, Sample 2336
 12. RV, lateral view, Sample 2345
 13. RV, lateral view (juvenile specimen), Sample 2336
 14. C, dorsal view, Sample 2336
- 15 - *Rehacythereis* aff. *bartensteini* (OERTLI)
RV, juvenile specimen, lateral view, Sample 2301
- 16-17 - *Rehacythereis bartensteini* (OERTLI)
 16. LV, lateral view, topotype, Gargas Hill
 17. RV, lateral view, topotype, Gargas Hill
- 18 - *Champanicytherura* cf. *kaye* WEAVER, 1982
RV, lateral view, Sample 2353
- 19 - *Microceratina* ? sp.
RV, lateral view, Sample 2337
- 20-21 - *Liasina rectimarginata* (NUYTS, 1990)
 20. C, right lateral view, Sample 2343
 21. C, left lateral view, Sample 2346

Plate caption

C = Complete shell, *i.e.* both valves

RV = Right valve

LV = Left valve

AM = Anterior margin

PM = Posterior margin

DM = Dorsal margin

VM = Ventral margin

